

Grand Challenge Initiatives in AI for Climate & Nature

Landscape Assessment
and Recommendations



Climate Change AI

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ABOUT THE ORGANIZATIONS

CLIMATE CHANGE AI (CCAI). CCAI is a global nonprofit that fosters impactful work leveraging AI for climate action by addressing critical gaps in expertise, education, coordination, and research-to-deployment infrastructure. CCAI launched in 2019 with the release of the foundational report “Tackling Climate Change with Machine Learning,” which provided a detailed overview of ways AI and machine learning can be used to support climate action. Since then, CCAI has convened a community of thousands of stakeholders across the academic, private, and public sectors through networking and knowledge-sharing events, summer schools and other educational programs, international policy reports, and multi-million dollar global grants programs.

BEZOS EARTH FUND (EARTH FUND). The Earth Fund is helping transform the fight against climate change with the largest ever philanthropic commitment to climate and nature protection. Jeff Bezos has committed \$10 billion in this decisive decade to protect nature and address climate change. By providing funding and expertise, we partner with organizations to accelerate innovation, break down barriers to success and create a more equitable and sustainable world. Join us in our mission to create a world where people prosper in harmony with nature.

CENTER FOR OPEN DATA ENTERPRISE (CODE). CODE is an independent US 501(c)(3) nonprofit organization based in Washington, D.C. CODE’s mission is to maximize the value of open and shared data for the public good, by working with government agencies, businesses, nonprofits, and researchers who are both data providers and data users. Since it was founded in January 2015, CODE has held dozens of Open Data Roundtables and workshops with the White House and Federal agencies on topics including energy and the environment, Federal data strategy, and health and healthcare. In addition to working with government agencies in the U.S. and internationally, CODE partners with private sector companies, foundations, and other nonprofit organizations to fulfill its mission. CODE has worked on several projects related to the risks of climate change since holding an Open Data Roundtable with NOAA on the topic in 2021.

DATA INNOVATORS (DI). DI is a social enterprise based in Johannesburg, South Africa, led by a team of young Africans who are passionate about making systemic change in development through data. DI’s mission is to help organizations push data boundaries to create positive futures. DI drives its mission by being at the forefront of innovation in the development sector, bringing world-class digital data solutions that democratize access to insights and simplify data management for all. DI has experience working on evaluations and digital solutions in 11 other developing countries, as well as globally in innovative research and development of fit-for purpose approaches in the Global South. Among its competencies are also data communication, programme monitoring, research, and learning, for partners in governments, philanthropies, foundations, private entities, and nonprofit organizations.

Grand Challenge Initiatives in AI for Climate & Nature: Landscape Assessment and Recommendations

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Executive Summary

Addressing the climate and nature crises requires rapid action and scalable solutions. Tools from artificial intelligence (AI), while no silver bullet, can play a potentially impactful role in accelerating progress through applications such as optimizing the energy efficiency of heating and cooling systems in buildings, monitoring species distributions with computer vision, or downscaling climate models to provide localized climate predictions.¹ Various interdisciplinary and cross-sectoral collaborations in AI for climate and nature have contributed a wealth of research, given rise to pilot projects, and in some cases led to more mature applications.^{2,3} However, there still remains significant work to turn potentially promising applications into scalable, deployed solutions that are truly having impact on the ground.

Grand Challenges can be a compelling mechanism to accelerate progress on climate and nature solutions, including in areas where AI may play an impactful role. Grand Challenges are a type of strategic innovation framework characterized by the mobilization of significant funding, attention, and resources towards specific, bold objectives, with the aim of driving large-scale collaboration and major breakthroughs with respect to these objectives.⁴ However, designing an impactful Grand Challenge is a nontrivial task. Grounded in a landscape assessment of over 200 Grand Challenges and open innovation initiatives, this report provides actionable insights and strategic recommendations to facilitate the design, implementation, and overall impact of future Grand Challenges in AI for climate and nature.

THE UNIQUE ROLE OF GRAND CHALLENGES

Grand Challenges differ from other funding instruments, such as incentive prizes or hackathons, in that they catalyze systemic change beyond the immediate solutions they generate, laying the groundwork for long-term impact. Past initiatives have driven a diverse set of systemic changes, such as accelerating innovation ecosystems, creating market incentives, enabling large-scale capacity building, and shaping policy frameworks. For example, the DARPA Grand Challenge on autonomous vehicles⁵ not only accelerated the development of autonomous driving technologies but also mobilized the research and deployment ecosystems, laying the groundwork for large-scale follow-on research and commercial ventures. Deciding which types of systemic changes are of importance provides insight into the intrinsic parameters that need to be defined during a Grand Challenge's design (notably, objectives, funding amounts, and technology readiness levels (TRLs)⁶). We identify seven different archetypes of Grand Challenges supporting different theories of change with respect to direct outcomes and broader systemic impacts, and characterize the funding amounts and TRLs associated with each archetype, as guidance for future Grand Challenge designs (Figure E.1).

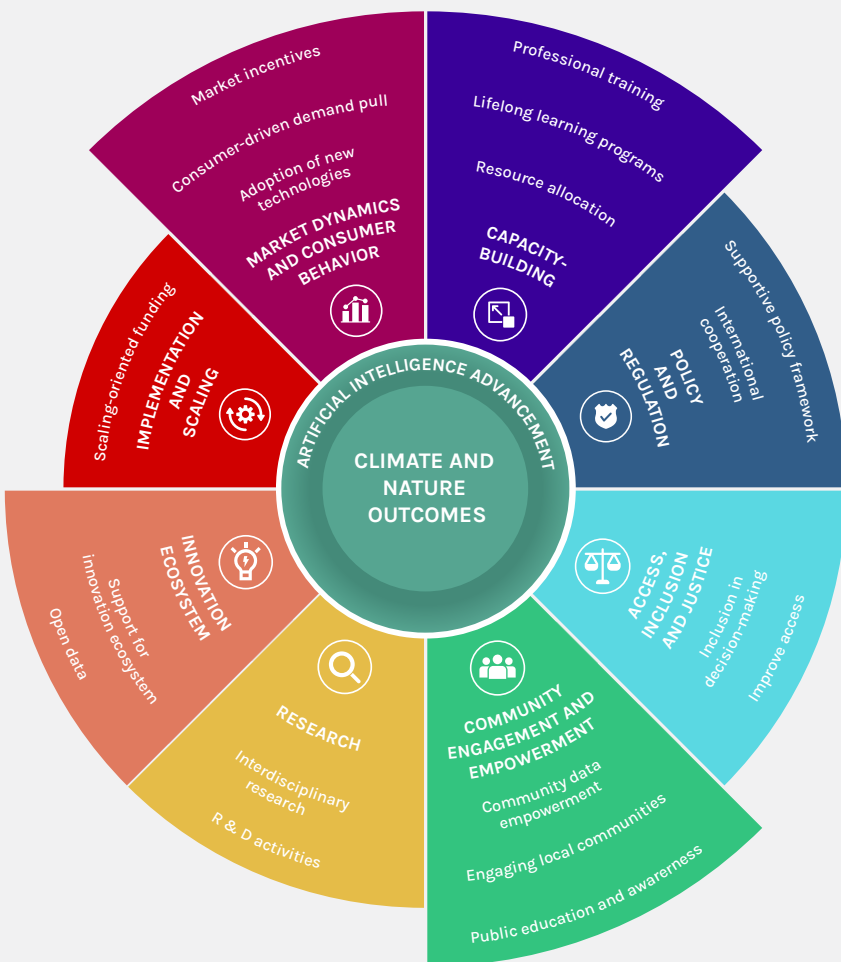
- 1 David Rolnick, Priya L. Donti, Lynn H. Kaack, Kelly Kochanski, Alexandre Lacoste, Kris Sankaran, Andrew Slavin Ross, Nikola Milojevic-Dupont, Natasha Jaques, Anna Waldman-Brown, Alexandra Sasha Luccioni, Tegan Maharaj, Evan D. Sherwin, S. Karthik Mukkavilli, Konrad P. Kording, Carla P. Gomes, Andrew Y. Ng, Demis Hassabis, John C. Platt, Felix Creutzig, Jennifer Chayes, and Yoshua Bengio. "Tackling Climate Change with Machine Learning." *ACM Computing Surveys*, 55(2), 2022 (preprint 2019).
- 2 David Sandalow, Colin McCormick, Alp Kucukelbir, Julio Friedmann, Trishna Nagrani, Zhiyuan Fan, Antoine Halff, Alexandre d'Aspremont, Ruben Glatt, Elena Méndez Leal, Kevin Karl and Alex Ruane, *Artificial Intelligence for Climate Change Mitigation Roadmap* (ICEF Innovation Roadmap Project, December 2023)
- 3 Gentine, Pierre, Geneva List, Kyoko Thompson, Theresa Pardo, Xin Li, George Berg, Lauren Bennett, et al., *Landscape Assessment of AI for Climate and Nature*. (May 2024). Available at [bezosearthfund.org/ai-climate-nature](https://www.bezosearthfund.org/ai-climate-nature).
- 4 Goldsmith, T., Speer, S., Asselin, R., Doyle, S., Hyder, A., Ebrahim, K., Flick, M., Bohunicky, B., & Dow, N. R. (2022, February 23). "Canada's Moonshot: Solving grand challenges through transformational innovation". Brookfield Institute for Innovation + Entrepreneurship.
- 5 <https://www.darpa.mil/about-us/timeline/-grand-challenge-for-autonomous-vehicles>
- 6 The technology readiness level (TRL) framework provides a characterization of the maturity of a technology, on a scale from 1-9 ranging from early-stage research and proofs of concept, to deployed and scaled technologies.

TRENDS IN PAST AND ONGOING INITIATIVES IN AI FOR CLIMATE AND NATURE

We evaluated 215 past and ongoing Grand Challenges and related open innovation initiatives (e.g., incentive prizes and crowdsourcing programs) taking place between 2015-2024, including 100 in AI for climate and nature and 115 in AI more broadly. We see a marked increase in the number of Grand Challenges and open innovation initiatives in AI for climate and nature post-2019 (Figure E.2), as well as a wide range of total funding amounts across these initiatives (Figure E.3). These initiatives have catalyzed cross-sectoral collaboration and produced innovative solutions ranging from early-stage research to fully deployed technologies. Many of these initiatives have garnered broad participation from across academia, government, industry, NGOs, and tech nonprofits; however, participant diversity significantly narrows as Grand Challenges progress, with the vast majority of winners coming from academia or industry (Figure E.4). In addition, the majority of initiatives are organized by institutions based in the Global North,⁷ with winners and funding

FIGURE E.1 LEVERS FOR IMPACT

Grand Challenges differ from other funding instruments, such as incentive prizes or hackathons, in that they catalyze systemic change beyond the immediate solutions they generate, laying the groundwork for long-term impact. Past initiatives have driven a diverse set of systemic changes, such as accelerating innovation ecosystems, creating market incentives, enabling large-scale capacity building, and shaping policy frameworks. Deciding which types of systemic changes are of importance provides insight into the intrinsic parameters that need to be defined during a Grand Challenge's design (notably: objectives, funding amount, and technology readiness level).



Discover & Disseminate

Lay foundations of research and disseminate knowledge

TRL: Low (1-3)

Funding: Up to \$1M



Innovation Forge

Develop innovative prototypes and nurture the innovation ecosystem

TRL: Mid (4-6)

Funding: \$1M-\$5M



Societal Shifts

Promote market-ready solutions with community-level impact

TRL: High (7-9)

Funding: \$5M-\$20M



Policy

Shape public policy and governance via actionable insights

TRL: High (5-8)

Funding: \$1M-\$10M



Nexus Network

Create robust platforms for coordination and capacity-building

TRL: Any

Funding: \$500K-\$10M



Resilience Rooted

Foster grassroots social innovation targeting local community needs

TRL: Low-Mid (2-5)

Funding: Up to \$2M



Scaling Up

Enable industry transformation for large-scale deployment and adoption

TRL: High (7-9)

Funding: \$10M-\$50M

distributions also substantially skewed toward the Global North (Figure E.5). This indicates a gap and a potential opportunity to increase the impact of future initiatives by garnering sustained global participation from across sectors and organization types.

STRATEGIC RECOMMENDATIONS

We provide a series of strategic recommendations to guide the framing, execution, and assessment of Grand Challenges in AI for climate and nature. These recommendations provide concrete guidance on choosing high-impact areas that are likely to benefit from a Grand Challenge; providing relevant (non-monetary) infrastructure, support, and resources to improve participation and maximize post-Challenge impact; important design parameters such as funding, phases, team selection and composition, deliverable type, and evaluation criteria; metrics for assessing the success of the overall Challenge; and methods to improve diversity, equity, and community impact. Our recommendations are summarized in Table E.1.

We particularly note that successful applications in the AI for climate and nature space often involve a heterogeneous set of actors, who need to collaborate to develop and implement the AI-for-climate/nature solution. These may include, e.g., researchers from across the natural and social sciences, engineering, and humanities; AI stakeholders from academia and the private sector; startups and technology nonprofits focused on AI for climate and nature; and a diverse range of deployment-oriented entities (e.g., heavily regulated industries such as the power sector, small private companies such as in smallholder farming, and non-profit organizations driving community action). This diversity comes with very different capabilities and cultures across relevant entities, as well as differing access to resources, support structures, and other prerequisites for AI implementation (such as computational resources and data infrastructure). Such considerations are particularly important to take into account when scoping Grand Challenge topics and sectoral foci (considering, e.g., innovation capacity and adoption readiness), when shaping the resources provided to participants before/during/after the Challenge, and when enabling the formation and selection of cross-functional participant teams.

It is also important to note that unlike purely AI-focused initiatives, the main objective of Grand Challenges in AI for climate and nature is to make progress in addressing climate and nature objectives. AI innovation is a vehicle to achieving this objective, as opposed to the primary goal in and of itself. In addition, climate and nature objectives warrant rapid, ambitious action on relatively short timeframes, often involve local action at a global scale, and require core consideration of ethics and equity. These factors must be central in shaping the evaluation of Grand Challenge projects (e.g., emphasizing deployability, allowing for variability across contexts, and allowing for simple or low-tech solutions) and in evaluating the impact of the Grand Challenge as a whole (e.g., considering direct climate and nature outcomes, additionality, and impacts on strengthening the overall climate and nature stakeholder ecosystem). These considerations further underscore the particular importance of engaging stakeholders from a wide variety of contexts and geographies, e.g., by ensuring Challenge accessibility and by engaging in strategic partnerships with a diverse range of organizations. ●

7 For our analysis, we use the Global North/South distinction from UNCTAD. See Section 4 and the following reference: United Nations Conference on Trade and Development. (2023). Countries, all groups hierarchy. https://unctadstat.unctad.org/EN/Classifications/DimCountries_All_Hierarchy.pdf

TABLE E.1 SUMMARY OF RECOMMENDATIONS

TOPIC	RECOMMENDATIONS
<p>Problem choice: Among high-impact problems, which ones are well-suited to be enabled by a Grand Challenge in AI for climate and nature, as opposed to other funding instruments?</p>	<ul style="list-style-type: none"> • Frame Grand Challenge goals based on Technological Readiness Levels (TRLs) and readiness levels for adoption • Ensure AI is indeed well-suited for the problem, and does not serve as a diversion or distraction from other effective climate and nature approaches • Prioritize areas with existing interest from complementary stakeholder communities • Deprioritize areas with disproportionately higher funding and media attention • Do not attempt to cover all areas of climate and nature “equally”
<p>Infrastructure, support, and resources: What accompanying infrastructure, support, and resources are necessary to unlock impact during and after the Grand Challenge?</p>	<ul style="list-style-type: none"> • Facilitate pre-Challenge training across different skill sets in AI and the relevant application areas • Implement a mentorship program • Foster peer-to-peer exchange • Facilitate access to computational resources and technology support necessary for AI software and AI-integrated hardware solutions • Provide post-Challenge publicity for participants and their solutions • Facilitate post-Challenge implementation support • Establish partnerships with a diverse range of organizations who can lend such infrastructure, support, and resources
<p>Project teams: What is the best structure and composition for participating teams? How many teams should there be?</p>	<ul style="list-style-type: none"> • Adopt a two-step approach to participant recruitment (open call plus direct intervention) • Encourage and guide participants to form teams across disciplines and sectors, including complementary expertise across AI and climate/nature • Do not be overly prescriptive in team requirements
<p>Funding: How much funding is needed overall and/or at different stages of the Challenge to drive innovation, implementation, and supporting infrastructure?</p>	<ul style="list-style-type: none"> • Clearly communicate at the outset how funding is allocated at each stage of the Challenge • Implement seed funding for early-stage exploration • Adopt a milestone-based funding structure • Consider designating special awards along specific predetermined axes • Consider funding mechanisms for participation in Challenge events • Plan for post-Challenge support and visibility
<p>Stages and project evaluation: How should the Challenge be designed with regards to timing, stages, and project evaluation?</p>	<ul style="list-style-type: none"> • Include phases for preparation, submission and initial screening, mentoring and development, and iterative evaluation • Allow for agile adaptation of the structure of the Grand Challenge • Shape project evaluation metrics with a view towards impactful and responsible deployment • Evaluate climate and nature outcomes using established metrics • Ensure metrics accommodate solutions across a range of problem settings • Include judges with a range of complementary expertise across AI and climate/nature, including deployment experts
<p>Deliverable type and intellectual property: What types of solutions should be sought and how will those solutions be managed?</p>	<ul style="list-style-type: none"> • Tailor deliverables to the problem at hand, including consideration of technological readiness level (TRL) and readiness levels for adoption • Encourage an open source approach to software tools, data, models, and academic research whenever possible, balanced with intellectual property (IP) protection • Provide customized intellectual property (IP) strategies, including patent filings and exclusive licensing agreements
<p>Success: How should the success of the overall program be evaluated?</p>	<ul style="list-style-type: none"> • Define a theory of change, covering both direct outcomes and systemic impacts in strengthening the space • Align the evaluation framework to the specific theory of change of the Grand Challenge • Combine quantitative metrics (e.g., reduction of greenhouse gas emissions) and qualitative metrics (e.g., energy consumption behaviors) for a holistic assessment of impacts on climate and nature • Assess impacts on AI innovation • Assess the likelihood of widespread adoption (considering both direct project outcomes and broader impacts on the stakeholder ecosystem) • Consider the long-term viability of projects • Estimate opportunity costs associated with participation • Develop a comprehensive monitoring and feedback mechanism, and share evaluation results
<p>Diversity and equity: What holds back diversity, equity, and meaningful community impact in practice, and how can those barriers be overcome?</p>	<ul style="list-style-type: none"> • Partner with community-based organizations for co-creation of Grand Challenge design • Consider a distributed leadership structure • Diversify participation via targeted outreach • Proactively address inclusion barriers such as connectivity and language • Don't just build for inclusivity; measure and learn

INITIATIVE TRENDS

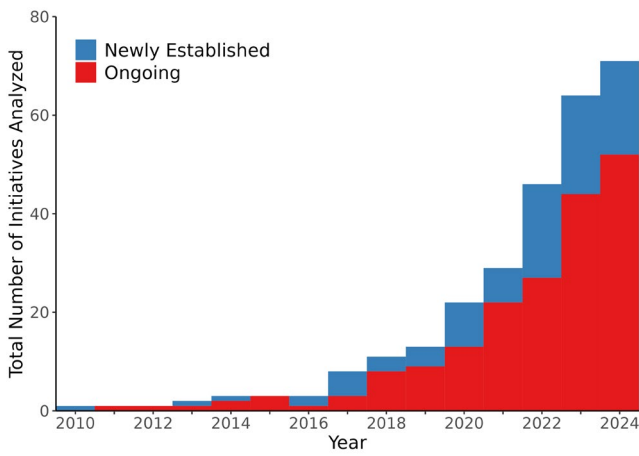


FIGURE E.2 Total number of Grand Challenges and open innovation initiatives in AI for climate and nature per year (both newly established & ongoing). We see a marked increase in the number of Grand Challenges in AI for climate and nature post-2019.

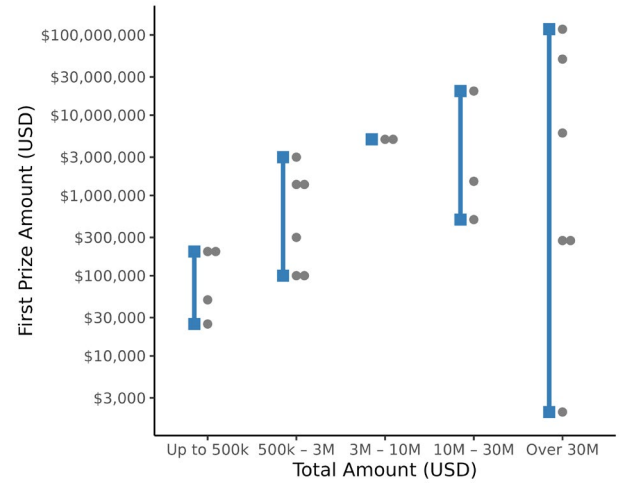


FIGURE E.3 Funding range for past Grand Challenges and open innovation initiatives in AI for climate and nature. (Dots indicate individual challenges. Blue bars indicate funding range across challenges.)

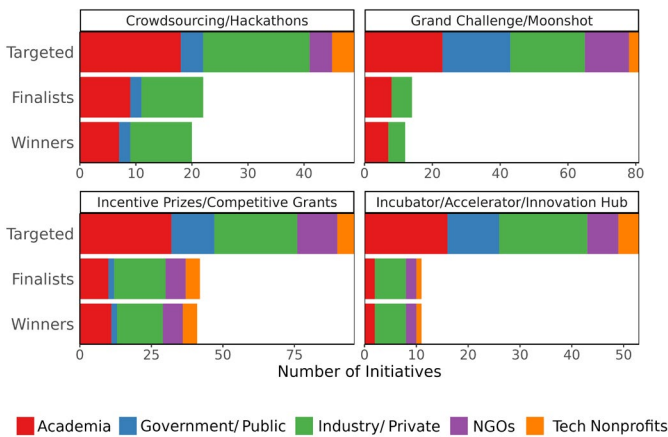


FIGURE E.4 Progression of participants through different stages of Grand Challenges and open innovation initiatives, broken down by initiative type and participant type. Despite broad initial participation across academia, government, industry, NGOs, and tech nonprofits, participant diversity significantly narrows as Grand Challenges progress, with the vast majority of winners coming from academia or industry.

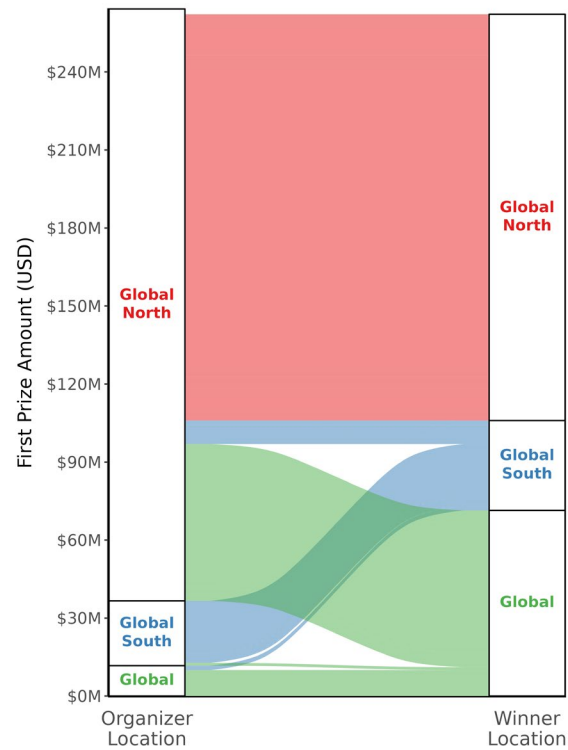


FIGURE E.5 Funding distribution from organizers to winners, classified using the UNCTAD Global North vs. Global South designation. The majority of initiatives are organized by institutions based in the Global North, with a distribution of winners and funding that is similarly skewed towards the Global North.

1. Introduction

The climate and nature crises represent some of the most critical issues of our time, requiring rapid action and scalable solutions across many sectors, geographies, and communities.^{8,9} While no silver bullet, tools from artificial intelligence (AI) can play a potentially impactful role in accelerating progress, when employed responsibly by and among relevant stakeholders. For instance, AI has been used for applications such as forecasting renewable energy production in power grids, optimizing heating and cooling systems in buildings, creating real-time flood reports from satellite imagery to aid in disaster response, analyzing corporate financial disclosures for climate-relevant information, accelerating the design of next-generation batteries, and enabling scalable real-time monitoring of biodiversity and ecosystems.^{10,11} Unfortunately, many such applications face bottlenecks in research and deployment, due to gaps in expertise, coordination, capacity, and infrastructure.^{12,13,14} This has prompted exploration among entities in government, philanthropy, and the private sector regarding how they can best fund or otherwise support the advancement of potentially impactful solutions.

GOALS OF THIS REPORT

In this report, we explore Grand Challenges as a potentially compelling mechanism for advancing impactful work in AI for climate and nature. Grand Challenges are large-scale initiatives that mobilize significant funding, attention, and resources towards ambitious yet achievable problems or objectives, with the aim of enabling technological, scientific, or societal transformation in service of these problems/objectives (see Section 2). Recent years have marked an increased interest in Grand Challenges both in AI for climate and nature and more broadly, with a pronounced increase in the number of Grand Challenges and open innovation initiatives in AI for climate and nature since 2019 (see Section 4). Amidst this increased interest, it becomes especially important to understand what particular value propositions Grand Challenges are meant to serve, when and whether Grand Challenges are the right mechanism to advance progress on a particular problem/objective, and how to best design and implement Grand Challenges to achieve their intended impacts.

In this report, we aim to shed light on these aspects in the context of AI for climate and nature, and provide actionable insights and strategic recommendations to improve Grand Challenges' design, implementation, and overall impact in the AI for climate and nature space. Our recommendations are grounded in a landscape assessment of over 200 Grand Challenges and related initiatives (across both AI for climate and nature and AI more generally) as well as interviews with organizers, participants, and other individuals engaged in past and/or ongoing Grand Challenges.

- 8 IPCC, 2023: Summary for Policymakers. In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001
- 9 WWF (2022). *Living Planet Report 2022 – Building a nature-positive society*. Almond, R.E.A., Grooten, M., Juffe Bignoli, D. & Petersen, T. (Eds). WWF, Gland, Switzerland.
- 10 David Rolnick, Priya L. Donti, Lynn H. Kaack, Kelly Kochanski, Alexandre Lacoste, Kris Sankaran, Andrew Slavin Ross, Nikola Milojevic-Dupont, Natasha Jaques, Anna Waldman-Brown, Alexandra Sasha Luccioni, Tegan Maharaj, Evan D. Sherwin, S. Karthik Mukkavilli, Konrad P. Kording, Carla P. Gomes, Andrew Y. Ng, Demis Hassabis, John C. Platt, Felix Creutzig, Jennifer Chayes, and Yoshua Bengio. "Tackling Climate Change with Machine Learning." *ACM Computing Surveys*, 55(2), 2022 (preprint 2019).
- 11 Gentine, Pierre, Geneva List, Kyoko Thompson, Theresa Pardo, Xin Li, George Berg, Lauren Bennett, et al., *Landscape Assessment of AI for Climate and Nature*. (May 2024). Available at bezosearthfund.org/ai-climate-nature.
- 12 Peter Clutton-Brock, David Rolnick, Priya L. Donti, Lynn H. Kaack, et al. (2021). *Climate Change and AI: Recommendations for Government Action*. *Global Partnership on AI Report*.
- 13 GPAI (2022). *Biodiversity & Artificial Intelligence: Opportunities and Recommendations*. *Global Partnership on AI Report*.
- 14 David Sandalow, Colin McCormick, Alp Kucukelbir, Julio Friedmann, Trishna Nagrani, Zhiyuan Fan, Antoine Half, Alexandre d'Aspremont, Ruben Glatt, Elena Méndez Leal, Kevin Karl and Alex Ruane, *Artificial Intelligence for Climate Change Mitigation Roadmap* (ICEF Innovation Roadmap Project, December 2023).

CAVEATS

In doing this analysis, we do not aim to suggest that AI-for-climate/nature approaches are necessarily “more worthy” of Grand Challenge-style funding than non-AI approaches. While AI can play an impactful role across many areas of climate and nature, it is not the right tool for every problem – ultimately Grand Challenges in the climate and nature space should prioritize impact on the climate and nature problems at hand, regardless of the types of methods used. We encourage climate/nature-focused funders to start with the climate and nature end goal(s) in mind, and only highlight a focus on AI if it is indeed well-suited for the problem and does not serve as a diversion or distraction from other effective approaches. (For AI-focused funders, we absolutely do encourage a thoughtful focus on AI for climate and nature, which can provide a compelling route to unlock novel axes of AI innovation^{15,16} while simultaneously furthering progress on some of the most pressing societal issues of our time.)

We also do not aim to suggest that Grand Challenges should replace or displace other funding mechanisms (such as grants, accelerators, or smaller-scale funding initiatives), either in the context of AI for climate and nature or more broadly. Ultimately, different kinds of funding mechanisms have different value propositions with respect to the type and scale of progress they aim to achieve, and can work together to jointly enable on-the-ground impact on desired societal goals. In particular, the explicit aim of a Grand Challenge is to channel significant resources and attention towards specific problems, and this can be a double-edged sword – potentially facilitating major progress on the problems at hand, but potentially drawing capacity away from other important problems outside the Grand Challenge’s scope. It is therefore critical that Grand Challenges be leveraged as a funding mechanism only when well-matched to the particular problems at hand, and to the needs of the overall climate space. (See also Sections 2, 5, and 7.)

FOR WHOM IS THIS REPORT WRITTEN?

This report aims to provide insights to several primary audiences that may be involved in the development, execution, or evaluation of Grand Challenges in AI for climate and nature.

- » **FUNDERS IN AI FOR CLIMATE AND NATURE.** For entities in government, philanthropy, and the private sector who aim to deploy funding/support in the space of AI for climate and nature, we aim to provide input on (a) what a Grand Challenge enables compared to other funding/support mechanisms, (b) how to scope or pick the focus of a Grand Challenge in the AI for climate and nature space, (c) important considerations for running, executing, and evaluating a Grand Challenge in AI for climate and nature, and (d) lessons learned from past Grand Challenges in AI for climate and nature and in AI more generally.
- » **GRAND CHALLENGE RUNNERS AND EVALUATORS.** For entities specialized in running/evaluating Grand Challenges and similar initiatives, we anticipate that the broad strokes of many of the recommendations in this report may be familiar. For this audience, we aim to provide insight on (a) particular considerations to keep in mind in the space of AI for climate and nature, both explicitly by providing important context and examples, and also implicitly via our choice of highlighted recommendations, (b) what these considerations imply regarding how a Grand Challenge in AI for

15 Priya L. Donti, David Rolnick, and Lynn H. Kaack (2022). Tutorial: Climate Change and Machine Learning: Opportunities, Challenges, and Considerations. *International Conference on Machine Learning*.

16 David Rolnick, Alan Aspuru-Guzik, Sara Beery, Bistra Dilikina, Priya L. Donti, Marzyeh Ghassemi, Hannah Kerner, Claire Monteleoni, Esther Rolf, Milind Tambe, et al. (2024). Application-driven Innovation in Machine Learning. *arXiv preprint arXiv:2403.17381*; forthcoming in *International Conference on Machine Learning*.

climate and nature should be run, and (c) gaps and lessons learned from past Grand Challenges in this space.

- » **PROBLEM OWNERS.** For the medium-/long-term owners and beneficiaries of AI for climate and nature solutions, we aim to provide insight on whether the problems they are aiming to address may be well-suited for a Grand Challenge, as compared to another funding/support mechanism. In particular, we provide guidance on the objectives, funding amounts, technological maturity levels, and adoption-related maturity levels often associated with Grand Challenges, in order to guide assessments of whether a particular AI-for-climate/nature problem may fit well within those parameters.
- » **OBSERVERS.** We anticipate this report may also be of interest to policymakers, media, and others who are not directly organizing or participating in Grand Challenges in AI for climate and nature, but who may observe or monitor the progress of these initiatives and aim to gauge their overall impact. For this audience, we aim to provide a framework for understanding the value proposition of a Grand Challenge and what it means for a Grand Challenge to actually be effective with respect to its stated outcomes and impacts. ●

2. Grand Challenges in AI for Climate and Nature

WHAT IS A GRAND CHALLENGE?

A Grand Challenge¹⁷ is a type of strategic innovation framework that seeks to enable transformative societal, scientific, or technological solutions in service of ambitious but achievable objectives.¹⁸ Often also referred to as “moonshots,”¹⁹ Grand Challenges tend to be characterized by the statement of a bold, specific vision or goal, coupled with the deployment of significant funding and resources to enable advancement towards this goal. In the process, Grand Challenges aim to generate excitement and attention, mobilize large-scale efforts from both existing and new players, and catalyze important systemic changes²⁰ that lay the groundwork for major breakthroughs. A famous example is DARPA’s Grand Challenge to accelerate the development of autonomous vehicles,²¹ which mobilized the research and deployment ecosystems²², kicked off considerable early-stage innovation to significantly advance the maturity of autonomous vehicle technologies, and established the foundations for large-scale follow-on research and commercial ventures.²³ Other prominent Grand Challenges have sought to develop technologies for real-time biodiversity monitoring in tropical rainforests (XPRIZE Rainforest²⁴), enhance medical regulatory systems through data platforms in sub-Saharan Africa (Strengthening African National Regulatory Authorities Data Systems to Enhance and Track Performance²⁵), and catalyze the development of sustainable aviation fuels to meet future demand while reducing emissions (Sustainable Aviation Fuel Grand Challenge²⁶).

Grand Challenges share important characteristics with other funding mechanisms and open innovation initiatives, such as grants, incentive prizes, hackathons, and incubators, but also differ in several key ways. We describe these other categories of funding mechanisms and open innovation initiatives below, including their relationship to Grand Challenges.

» **GRANTS:** This category encompasses programs that provide up-front funding to individuals or teams to execute on projects. Like Grand Challenges, grants programs may deploy funding at large scale, select awardees through a competitive process, and/or aim to advance particular objectives and create systemic change through the framing of the grant purpose and criteria. A key difference between grants and Grand Challenges is that grants programs provide funding up-front to facilitate project execution, whereas Grand Challenges tend to award prizes to successful projects after-the-fact. That said, some Grand Challenges incorporate grant-like elements, e.g., inviting proposals from prospective participants and awarding up-front seed funding for the initial Challenge stage(s) (see Section 7.4). Another key difference is that grants programs also tend to be somewhat broader in focus than Grand Challenges and invite a more heterogeneous set of projects, in contrast to concentrating resources towards a more specific goal or objective as in the case of Grand Challenges.

- 17 In this report, we chose to capitalize the term “Grand Challenge”, and often abbreviate it as “Challenge.” If “challenge” is not capitalized, it refers to other challenge formats more broadly.
- 18 Goldsmith, T., Speer, S., Asselin, R., Doyle, S., Hyder, A., Ebrahim, K., Flick, M., Bohunicky, B., & Dow, N. R. (2022, February 23). Canada’s Moonshot: Solving grand challenges through transformational innovation. Brookfield Institute for Innovation + Entrepreneurship.
- 19 Scudellari, M. Big science has a buzzword problem. *Nature* 541, 450–453 (2017). <https://doi.org/10.1038/541450a>
- 20 Howard-Grenville, J., & Spengler, J. (2022). Surfing the grand challenges wave in management scholarship: how did we get here, where are we now, and what’s next?. In *Organizing for societal grand challenges* (pp. 279-295). Emerald Publishing Limited.
- 21 <https://www.darpa.mil/about-us/timeline/-grand-challenge-for-autonomous-vehicles>
- 22 Lee, A. B. (2007). *Stimulating Innovation and Accelerating the Development of Complex and Slowly Maturing Technologies Through Advanced Technology Prize Competitions* (p. 0046). Army War College, Carlisle Barracks, PA.
- 23 Defense Advanced Research Projects Agency (DARPA). (2014, March 13). The DARPA Grand Challenge: Ten Years Later. Retrieved from <https://www.darpa.mil/news-events/2014-03-13>
- 24 <https://www.xprize.org/prizes/rainforest>
- 25 <https://gcgh.grandchallenges.org/challenge/strengthening-african-national-regulatory-authorities-data-systems-enhance-and-track>

- » **INCENTIVE PRIZES/COMPETITIVE GRANTS:** This category encompasses pay-for-performance initiatives that incentivize participants to achieve predefined targets or goals by awarding resources (monetary or non-monetary) to participants who successfully achieve those goals. Grand Challenges are often implemented as incentive prizes, where participants are assessed on their performance via an established judging or evaluation process, and “winning” participants are awarded and potentially advanced to a next stage. However, not all incentive prizes are Grand Challenges. While Grand Challenges are typically ambitious, large-scale initiatives aimed at solving complex societal problems that require significant innovation and cross-sector collaboration, incentive prizes can also be used to drive progress toward more targeted, near-term objectives. These narrower incentive prizes may focus on specific technical challenges or milestones that contribute to a larger goal, but do not necessarily constitute a “moonshot” effort in and of themselves.
- » **CROWDSOURCING INITIATIVES/HACKATHONS:** Crowdsourcing encompasses various approaches such as hackathons, citizen science projects, and other initiatives aimed at generating ideas or developing tools and applications through collective participation. Hackathons typically happen at much shorter time scales and with fewer resources than Grand Challenges, and can aim either at open ideation of diverse projects or at solving a smaller shared problem with potentially pre-defined datasets and evaluation metrics (rather than addressing a larger-scale objective, as in a Grand Challenge). Some hackathons are also largely pedagogical in nature (e.g., many student-focused hackathons) rather than being primarily focused on the impact of the deliverables. Other crowdsourcing types, such as citizen science projects, differ greatly from Grand Challenges in that they are not competitive in nature and may not even involve funds for participants.
- » **INCUBATOR/ACCELERATOR/INNOVATION HUBS:** These programs provide support to teams or individuals by matching them with mentors, resources, facilities, or shared services to help develop and scale their innovations. Incubators typically focus on early-stage startups, providing mentorship, networking opportunities, and a workspace, while accelerators offer intensive programs aimed at creating rapidly-growing businesses. Innovation hubs serve as physical or virtual spaces that foster collaboration and innovation within a specific ecosystem. This group of initiatives revolves around providing support structures and environments for the purpose of entrepreneurship, rather than for achieving a specific objective like in Grand Challenges; that said, Grand Challenges may adopt inspiration from incubators/accelerators/innovation hubs with respect to the particular support and resources they can provide for Grand Challenge participants (see [Section 7.2](#)).

AI FOR CLIMATE AND NATURE

Grand Challenges in AI for climate and nature seek to address important problems related to climate change and/or nature, with objectives such as reducing greenhouse gas emissions, slowing biodiversity loss, and protecting people’s livelihoods, by leveraging AI and machine learning methods. AI can help with these objectives, for example, by improving forecasts of renewable energy, monitoring species distributions via computer vision, or downscaling climate models for localized climate predictions.²⁷ Despite their potential,

²⁶ <https://www.energy.gov/eere/bioenergy/sustainable-aviation-fuel-grand-challenge>

²⁷ David Rolnick, Priya L. Donti, Lynn H. Kaack, Kelly Kochanski, Alexandre Lacoste, Kris Sankaran, Andrew Slavin Ross, Nikola Milojevic-Dupont, Natasha Jaques, Anna Waldman-Brown, Alexandra Sasha Luccioni, Tegan Maharaj, Evan D. Sherwin, S. Karthik Mukkavilli, Konrad P. Kording, Carla P. Gomes, Andrew Y. Ng, Demis Hassabis, John C. Platt, Felix Creutzig, Jennifer Chayes, and Yoshua Bengio. “Tackling Climate Change with Machine Learning.” *ACM Computing Surveys*, 55(2), 2022 (preprint 2019).

many AI-for-climate/nature approaches exist only as early-stage research projects or are tested in pilots, and large scale commercial or public-interest deployment of such AI-driven solutions has largely not yet happened (though with some notable exceptions, such as renewable energy forecasting²⁸).

Successful applications in this space involve a diverse set of actors, who need to collaborate to develop and implement the AI-for-climate/nature solution. The climate and nature space spans almost all public and private sectors, and it is characterized by numerous actors with very different attributes, cultures, and AI readiness levels. For example, heavily regulated industries (such as the power sector) play a decisive role in addressing climate change, as do small private companies (such as smallholder farms) and non-profit organizations driving community action. Researchers from different disciplines across the natural and social sciences, engineering, and humanities are involved in guiding climate action and innovating on solutions across many different sectors. In addition, many AI stakeholders are interested in climate and nature topics, both from academia and the private sector. Various successful interdisciplinary and cross-sectoral collaborations have emerged (including academic and private-sector labs anchored across disciplines and sectors) in addition to an active ecosystem of startups and technology nonprofits focused on AI for climate and nature.

This diversity comes with different access to resources, support structures, and other prerequisites for AI implementation. For instance, some AI applications require computational resources that are so large that only few stakeholders (e.g., large tech companies) have access to them. Since smaller players such as startups or academic labs do not have those resources, this fundamentally constrains the types of methods they can develop. Access to data can also be a decisive factor for success. Many organizations that are relevant to climate and nature are not yet set up with data management infrastructure that would enable them to experiment with AI approaches.

The AI for climate and nature space, while promising, also provides fertile ground for exaggerated hopes and misaligned incentives. Public interest in the intersection of AI and sustainability has surged in recent years, perhaps unsurprisingly given the interest in each topic independently. This widespread enthusiasm often contrasts starkly with the deeply technical, and sometimes niche, nature of many impactful AI-for-climate/nature approaches. The divergence suggests some actors developing AI-for-climate/nature solutions may be driven more by the zeitgeist than by the potential for scalable innovations with real-world impact.

To ensure that solutions meaningfully advance sustainability goals, then, it is essential to measure the impact on environmental outcomes, such as greenhouse gas emissions and resilience to climate-induced changes. Such impact assessment of AI is a nascent area, but initial frameworks exist.²⁹

WHAT'S DIFFERENT ABOUT A GRAND CHALLENGE IN AI FOR CLIMATE AND NATURE?

The focus on climate and nature comes with some features that distinguish these initiatives from other Grand Challenges. Comparing Grand Challenges in AI for climate and nature to Grand Challenges focusing on AI more broadly, we highlight several key differences:

- » **AI AS A MEANS, NOT AN END:** The main objective of AI for climate and nature Challenges is to make progress in addressing climate change and protecting nature. This makes AI innovation a vehicle to achieving this objective, not a goal in and of itself. One may encounter the situation

²⁸ Peter Clutton-Brock, David Rolnick, Priya L. Donti, Lynn H. Kaack, et al. (2021). Climate Change and AI: Recommendations for Government Action. *Global Partnership on AI Report*.

²⁹ Lynn H. Kaack, Priya L. Donti, Emma Strubell, George Kamiya, Felix Creutzig, and David Rolnick. *Aligning Artificial Intelligence with Climate Change Mitigation*. Nature Climate Change, 2022.

where — even though AI initially offered a promising lead to solve a problem — the solution ultimately does not use AI. When climate and nature are front and center in a Challenge, such non-AI solutions should have a chance to win.

- » **NOT ONLY SOFTWARE:** AI for climate and nature Challenges may require more resources and time than other AI challenges. Grand Challenges are a vehicle to solve really difficult problems, which in the climate and nature space often require large investments and longer timelines, e.g. to develop new climate technologies like direct air capture or to ensure the on-the-ground integration of solutions within key stakeholder communities. Groundbreaking AI-for-climate/nature solutions may similarly need to involve integration between AI-enabled software and hardware, and accelerating only the software component (as in some AI Grand Challenges) may not be enough.
- » **MEASURING CLIMATE AND NATURE IMPACTS:** Given that impact on climate and nature is front and center, impact assessment with climate and nature metrics — including both the impacts of the AI application and the computing/hardware-related footprint of the AI approach itself — is particularly warranted as part of the reporting and/or evaluation. This assessment should likely be given greater consideration than other performance metrics typical for AI benchmarks, such as accuracy, precision, or recall.
- » **TECHNOLOGICAL AND SOCIOTECHNICAL READINESS FOR IMPACT:** Unlike many AI challenges that are focused solely on advancing Technology Readiness Levels (TRLs),

BOX 2.1 READINESS FRAMEWORKS

Over the years, various scales have been developed to assess the maturity of solutions with respect to their underlying technology and their ability to be deployed effectively. This box provides an overview of several frameworks for assessing a solution's "readiness." This list of frameworks is not meant to be exhaustive, but instead illustrative with respect to the different kinds of considerations that are important to take into account when assessing and improving the maturity of an AI-for-climate/nature solution.

TRL — Technology Readiness Level

The technology readiness level (TRL) framework provides a characterization of the maturity of a technology, on a scale from 1-9 ranging from early-stage research and proofs of concept, to deployed and scaled technologies.³⁰ The framework originated with NASA and has been widely adopted, including by the funding mechanisms of the European Union.³¹ Because the framework solely focuses on the readiness of technologies, rather than the broader context in which they are employed, numerous other ways to assess readiness levels have been proposed that can be used instead of or in combination with TRLs.

MLTRL — Machine Learning Technology Readiness Level

The TRL framework has since been adapted to describe the maturity of machine learning applications (MLTRL), and "TRL Cards" have been proposed to communicate the TRL of a model or use case.³² MLTRL phases include research, prototyping, productization, and deployment, and are followed by continuous monitoring and maintenance of an application after deployment. This framework is very focused on the AI/machine learning part of a solution for assessing end-to-end applications, the broader TRL framework may sometimes be more useful.

ARL — Adoption Readiness Level

Despite a technology being mature and deployment-ready, technological deployment may still fail due to issues with adoption and integration into existing systems. To take into account relevant project and adoption risks, the US Department of Energy's Office of Technology Transitions has developed the Adoption Readiness Levels (ARLs) framework.³³ The core risk areas addressed within the ARLs framework include value proposition, market acceptance, resource maturity (e.g., of capital, infrastructure, and workforce), and license to operate (including, e.g., policy/regulatory risks and community perception).

MRL — Market Readiness Level

The TRL framework primarily considers factors of technological innovation related to the notion of "technology push" but does not include factors related to the "market pull" and commercial viability of a technology-based solution. Additional frameworks have been proposed to assess the maturity of the market to demand the solution in question, such as the Market Readiness Levels (MRL).^{34,35} Here, readiness levels range from an initial recognition that "something is missing" in the market, to the identification of specifics of a new product based on a more targeted assessment of customer needs and market size, to initial product validation with potential customers, to building a product with proof of scalability in the market.

SRL — Societal Readiness Level

Instead of viewing different axes of readiness separately, integrated frameworks such as Sociotechnical Readiness Levels (SRLs)³⁶ aim to fundamentally interleave considerations of technology readiness, adoption/market readiness, community acceptance, and ethical considerations (e.g., considerations of potential harms and inequities) within one framework. Levels range from early-stage technology development alongside initial identification of potential societal uses and risks, to validation of medium-stage technologies alongside users and community groups, to technological deployment alongside mechanisms for continuous monitoring/improvement of societal outcomes and risks.

applications in the climate and nature space may sometimes span several TRLs or have a stronger focus on alleviating bottlenecks to deployment for solutions that are already in upper TRLs. For successful deployment, the environment in which the AI solution is to be implemented needs to accommodate necessary changes, and often institutional, legal, or practical barriers exist. Concepts such as adoption readiness level (ARL), market readiness level (MRL), and sociotechnical readiness level (SRL) aim to capture these factors (see Box 2.1). This has implications for the composition of participating teams, which may need to involve researchers from AI and from the climate/nature domain, (software and data) engineers, implementing entities and industries, end users, individuals with policy and/or commercial expertise, and other relevant stakeholders.

- » **AMBITIOUS TIMEFRAME AND GLOBAL SCOPE:** Climate and nature challenges warrant rapid, ambitious action on relatively short timeframes, and often involve local action at a global scale. Grand Challenges focused on climate and nature outcomes must therefore be cognizant of these timeframes, and place particular importance on engaging stakeholders from a wide variety of contexts and geographies.

Similarly, there are some aspects that distinguish Grand Challenges in AI for climate and nature from those on climate and nature more broadly:

- » **AI COMMUNITY CULTURE:** The AI for climate and nature space draws many benefits from the AI community. Those may include the shorter (agile) development and production cycles, new venues to showcase research and products, open-source availability of many frameworks/tools and methods, and potential funding coming from AI funding streams. On the other hand, new challenges can arise with AI and the involvement of the AI community, such as a cultural tendency to move fast and take risks, a tendency to overlook existing knowledge and user interests, a tendency to downweight considerations important for real-world last-mile deployment, and inherent risks and limitations of the technology that the community has not yet successfully addressed. AI researchers/practitioners also often serve as algorithmic contributors rather than end-to-end “problem owners” in climate and nature domains, perhaps in contrast to researchers/practitioners in other areas of science and engineering whose fields are expressly focused on a climate-relevant sector; this underscores the need for teams in which “non-AI” stakeholders are also equipped with enough AI expertise to carry forward solutions.
- » **NOT METHOD-AGNOSTIC:** The space of AI for climate and nature is not method-agnostic, as it specifically seeks to foster climate and nature approaches that make use of AI. The usefulness and feasibility of the AI application is front and center: as such, Grand Challenges in AI for climate and nature should be picked such that AI is likely to be useful. This makes AI-specific considerations, e.g., the data ecosystem or maturity of the specific AI methods that would be applicable, a relevant consideration when selecting between different climate and nature areas for the Grand Challenge. In turn, it is also important to not consider areas where AI is unlikely to play a significant role, or where AI may serve to divert or distract from other potentially effective approaches.
- » **DATA IS CENTRAL:** The climate and nature space involves many different kinds of domains and problems, and the availability of high-quality data can turn into a deciding factor for the success of AI Challenges. In many

30 Mankins, John C. “Technology readiness levels.” White Paper, April 6.1995 (1995): 1995.

31 Héder, Mihály. “From NASA to EU: the evolution of the TRL scale in Public Sector Innovation.” *The Innovation Journal* 22.2 (2017): 1-23.

32 Lavin, A., Gilligan-Lee, C.M., Visnjic, A. et al. Technology readiness levels for machine learning systems. *Nat Commun* 13, 6039 (2022). <https://doi.org/10.1038/s41467-022-33128-9>

33 <https://www.energy.gov/technologytransitions/adoption-readiness-levels-arl-complement-trl>

34 Hjort, S. S., & Brem, A. M. (2016). How to assess market readiness for an innovative solution: The case of heat recovery technologies for SMEs. *Sustainability*, 8, 1-16.

35 <https://www.innovateukedge.ukri.org/blog/understanding-market-readiness-level#>

36 Verma, A., & Allen, T. (2024). A sociotechnical readiness level framework for the development of advanced nuclear technologies. *arXiv preprint arXiv:2403.18204*.

instances, datasets are scarce and hard to get/collect, and dataset creation may be an important component of the Challenge. Synthetically generated/simulated data might be useful in training the models, but is often not sufficient to ensure the safety and reliability of the developed solutions. Realistic simulation environments, which are particularly relevant for the development of control-based methods (e.g., using reinforcement learning), are also relatively nonexistent in many climate and nature settings, and the development of good simulators may likewise be an important component of an AI-for-climate/nature Challenge. ●

3. Methodology

DESK RESEARCH TO IDENTIFY RELEVANT GRAND CHALLENGES AND OPEN INNOVATION INITIATIVES

Initial desk research to survey the landscape of Grand Challenges and other open innovation initiatives included both initiatives focusing on AI for climate and nature specifically (AI4CN initiatives) and AI more broadly (AI initiatives), and uncovered 100 and 115 initiatives, respectively (Appendix A and B). Of the identified 100 AI4CN initiatives, many were theme-agnostic, allowing participants to narrow down focus areas (25%), whereas others had specific focus areas including Power and Energy Systems (19%), Agriculture, Forestry, and Land Use (16%), Climate Science and Monitoring (14%), and (less frequently) Biodiversity and Ecology, Transportation, and Industry. Our AI4CN sample contained 28 Grand Challenges and 72 other open innovation initiatives (incentive prizes/competition prizes, crowdsourcing/hackathons and incubators/accelerators/innovation hubs). The project team recorded relevant attributes for each initiative such as organizations involved, the problem statement, and the types of submissions, among others. Relevant reports, articles, and project briefs were also gathered in this phase.

LARGE-SCALE SURVEY AND CORE STAKEHOLDER IDENTIFICATION

This phase focused primarily on building a survey to augment desk research and identify a list of stakeholders who have been involved with Grand Challenges. The survey was designed to gather information on additional relevant Grand Challenges and was distributed via social media platforms and through CCAI's Community Platform. With 72 responses, this survey helped to identify a number of relevant stakeholders who expressed interest in discussing their work. In parallel, additional desk research was carried out to identify stakeholders who were part of Grand Challenges identified both during the desk research phase and via the survey. Stakeholders were categorized as judges (experts evaluating solutions), participants (individuals and teams developing solutions), organizers/partners (leading Challenge design and implementation or contributing expertise and resources), sponsors/funders (providing financial support), mentors (providing guidance to participants), and program evaluators (assessing overall impact and outcomes of the program).

INTERVIEWS AND FOCUS GROUPS WITH TARGET STAKEHOLDERS

After identifying the stakeholders, the third phase of research included 55 structured interviews and 3 focus group discussions with these stakeholders

(a list of interviewees is in [Appendix C](#)). The outreach plan took place in several stages based on stakeholder response rates, referrals, and initial findings of the interview conversations. One-on-one interviewees received the questions in advance, and discussed these questions during a 45-minute interview with a designated interviewer and notetaker. Questions aimed to understand the value propositions, design, and opportunities for improvement of the Challenge. In some instances, we also interviewed several people at the same time in focus groups, sometimes bringing together stakeholders who were part of the same Challenge or sometimes grouping interviewees across Challenges. See [Appendix D](#) for a list of stakeholder interview questions.

ANALYSIS AND GAP IDENTIFICATION OF EXISTING DATA

After completing 63 interviews, emerging themes and areas of interest were identified. The data gathered from interviews, surveys, and the literature review were organized and updated in a centralized repository. Throughout the data collection process, the project team held brainstorming sessions to consolidate findings and prioritize important questions for additional investigation.

REPORT SYNTHESIS AND STRUCTURING

The recommendations for organizers of potential future Grand Challenges in AI for climate and nature were developed in an iterative and agile process, which included multiple brainstorming sessions and conceptual discussions with the whole team and subgroups. The recommendations were developed based on (1) all desk research, (2) interview notes, transcripts and/or recordings, (3) a list of predefined questions to be answered through the report, and (4) analyses based on the aforementioned information, including a stakeholder analysis matrix (depicting the expectations, objectives, roles, and engagement of different types of stakeholders).

4. Landscape Analysis

We identified 100 Grand Challenges and open innovation initiatives in AI for climate and nature, of which 28 were Grand Challenges and moonshots, 34 were incentive prizes and grants (both competitive and noncompetitive), 20 were hackathons and crowdsourcing events, and 18 were incubators, accelerators, and innovation hubs (see Appendix A). To analyze the landscape of initiatives on this topic, we assessed factors such as when they were launched, what technology readiness levels (TRLs) were targeted, what types of solutions were encouraged as an outcome, and how much funding was provided. We also took a closer look at who participated in these initiatives by analyzing the breakdown of participant types (academia, government, private sector, NGOs, and tech nonprofits) by initiative type and stage; the geographic distribution of organizers, participants, and funding; and participation modalities (in-person, online, or hybrid). In our analysis, we compare Grand Challenges to other types of initiatives.

INITIATIVE LAUNCH DATES AND PROGRESS

In Figure 4.1, we report the number of Grand Challenges and open innovation initiatives in AI for climate and nature per year in our dataset, distinguishing between newly-established initiatives and recurring/ongoing initiatives taking place in each year. Our analysis shows that Grand Challenges and open innovation initiatives in AI for climate and nature (AI4CN) are scarce until 2015. We only identified the Catalyst Energy Innovation Prize, the Wendy Schmidt Ocean Health XPRIZE, and a call for sustainable energy solutions with EIT InnoEnergy during this period. Post-2015, AI4CN Challenges and initiatives have gained traction and become more frequent, with an inflection point around 2018-2019. A few organizing entities have run a series of Grand Challenges and open innovation initiatives,

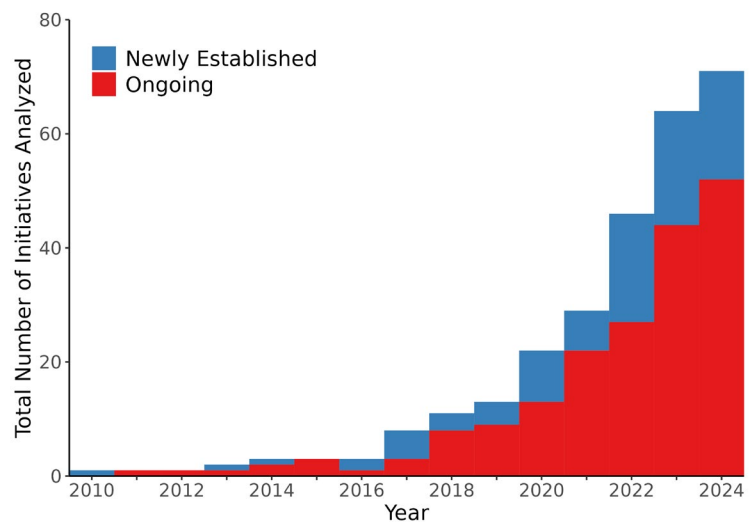


FIGURE 4.1 Total number of Grand Challenges and open innovation initiatives in AI for climate and nature per year (both newly established & ongoing). We see a marked increase in the number of initiatives in AI for climate and nature post-2019.

notably the European Commission, XPRIZE Foundation, Electric Power Research Institute (EPRI), Enterprise Neurosystem, Bill & Melinda Gates Foundation, Wellcome Trust, DrivenData, ECMWF, and the University of Maryland.

TECHNOLOGY READINESS LEVELS

Analyzing the TRLs that a Challenge targets is vital for understanding whether efforts are predominantly focused on early-stage methodological innovation (low TRL), prototype development (medium TRL), or deployment and scalable solutions (high TRL). As shown in Figure 4.2, the Grand Challenges in our sample focus more on high-TRL, deployable solutions than other initiative types, and somewhat less on foundational, low-TRL innovation. The difference in the distribution of TRLs between Grand Challenges and other initiatives is marginal, however, indicating relatively balanced support for different technological maturity levels across different types of open innovation initiatives.

SOLUTION TYPES

We analyze the types of solutions solicited by Grand Challenges, i.e., the kinds of outputs there were accepted as submissions in the different initiatives (Figure 4.3). See Appendix D.5 for additional details on the types of solutions. Grand Challenges and other open innovation initiatives have provided approximately equal attention to soliciting the development of AI models, prototypes, and software (each solution type was admissible in 35-40% of all initiatives). Grand Challenges, however, are more likely to solicit research projects and proposals than other initiatives. Specifically, Grand Challenges request research

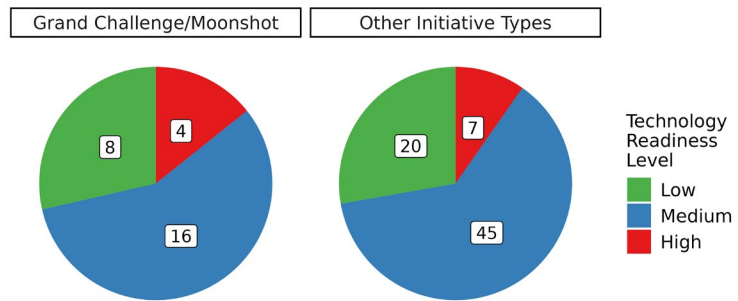


FIGURE 4.2 TRL distribution for Grand Challenges (left) and other types of initiatives (right) in climate and nature. Low, medium, and high refer to a TRL of 1-3, 4-6, and 7-9, respectively.

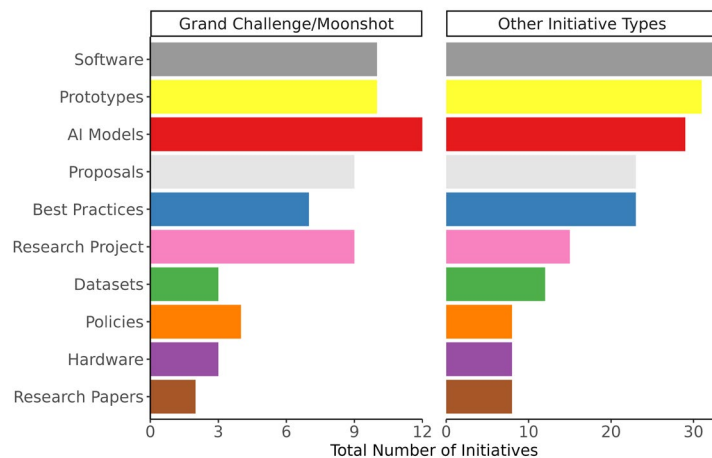


FIGURE 4.3 Distribution of solution types across Grand Challenges (left) and all other initiative types (right) in AI for climate and nature.

projects and proposals 35% of the time, compared to 20% and 30%, respectively for other open innovation initiatives. This could be a sign that Grand Challenges tend to focus more on the projects at large rather than prescribing specific solution types, like datasets. Otherwise, the accepted (or intended) forms of submission do not differ significantly between Grand Challenges and other types of initiatives. Across all types of initiatives, notably also Grand Challenges, we notice an outsized focus on the development of software over hardware.

FUNDING AMOUNT AND SOURCES

Grand Challenges often provide funds to participants and/or winners in a tiered fashion, where funds are made available to successful participants at different (intermediate) stages of the process and the final (“grand”) prize is awarded at the last tier of the Grand Challenge. As shown in Figure 4.4, there is a clear positive correlation between the total amount of funding and the size of the grand prize, i.e., initiatives that are generally more highly funded tend to have a larger grand prize. That said, there is significant variability regarding the first prize amount among initiatives at the same total funding tier. This is largely due to the fact that some Grand Challenge organizers opt to allocate the entire prize pool for one winner, while others prefer to offer smaller amounts of intermediate prizes, of which the final prize is only a portion. In general, and perhaps surprisingly, the total allocated funding amount exceeds the money actually distributed to participants and winners. This gap may result from a number of factors, including operational and marketing costs, non-

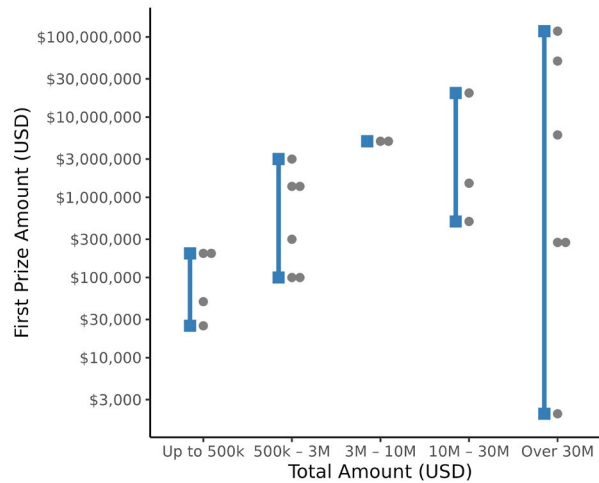


FIGURE 4.4 Funding range for those Grand Challenges and open innovation initiatives in AI for climate and nature that publicize the values of allocated funds for the first prize. The x-axis corresponds to the range of the total amount allocated per initiative, and the y-axis corresponds to the value of the individual first (“grand”) prize amount, all in USD.

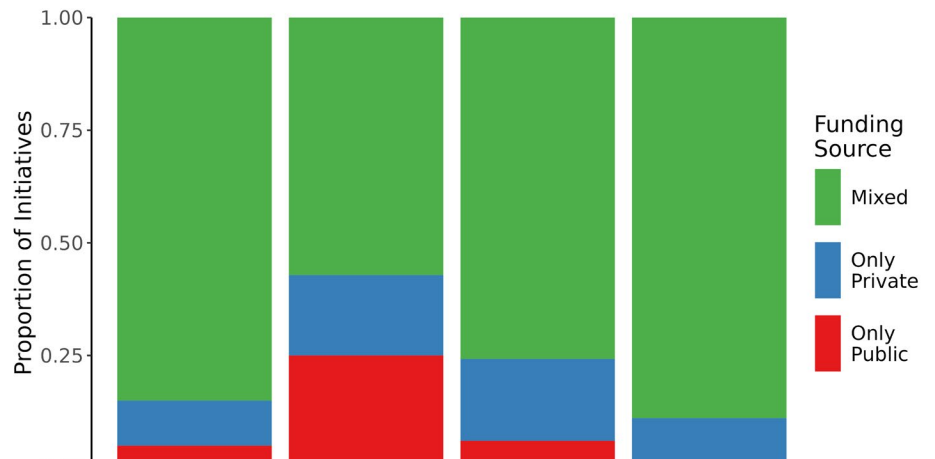


FIGURE 4.5 Distribution of sponsors/funding sources (public vs. private sector) for all 100 AI4CN Grand Challenges and open innovation initiatives.

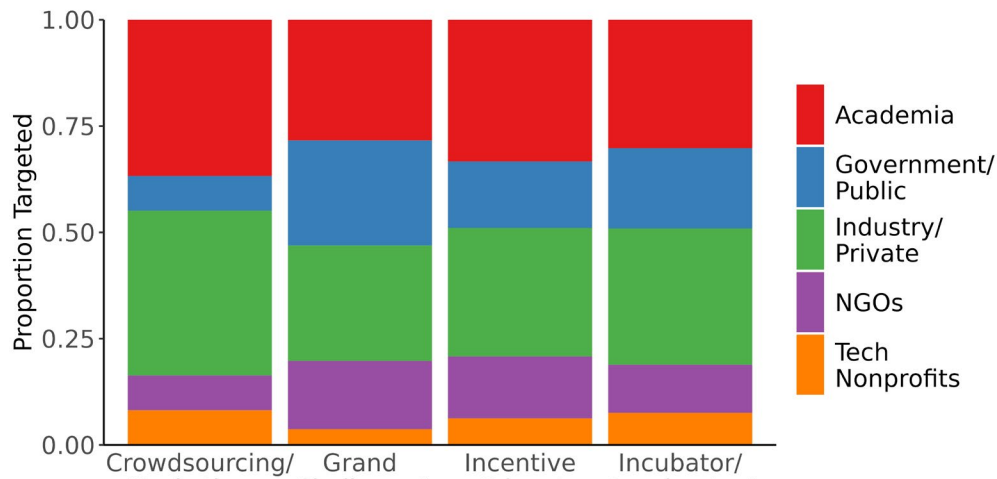


FIGURE 4.6 Breakdown of participants by initiative type for all initiatives in AI for climate and nature. Note that initiatives may target more than one type of participant at a time and that each initiative, which may encompass multiple iterations, is counted as one unit in this analysis.

monetary support services, and unallocated/unused prize money. As shown in Figure 4.5, the source of funding is predominantly a mix of public and private sources across all initiative types. The proportion of purely public or privately-funded Grand Challenges is about equal.

BREAKDOWNS OF PARTICIPANT TYPE IN DIFFERENT INITIATIVE TYPES

Figure 4.6 shows the distribution of participants per type of challenge, i.e., whether participants were mainly affiliated with an academic institution, governmental body, private sector institution, non-governmental organization (NGO), or tech nonprofit. The participant profile varies across initiative types: governmental bodies and NGOs made up a smaller proportion of participants in hackathons than in Grand Challenges, which emphasize a broader vision for methodological innovation and adoption. The converse is true for for-profit companies: they constitute more of the participants in hackathons, whose shorter duration and time horizons likely align better with companies' budgeting and business needs.

In Grand Challenges in particular, philanthropic organizations play a significant role, acting as sponsors/funders in 32% of Challenges and as partners in 21%. (NASA Harvest is the only example where philanthropic organizations are partners but not funders/sponsors.) Of the Grand Challenges funded solely by private entities, all have received philanthropic funding, and 40% have partnerships with philanthropic organizations. Those funded only by public entities are of course not funded by philanthropic organizations, but 15% of them have philanthropic partners. For Grand Challenges with mixed funding sources, 23% have received financial support from philanthropic sources.

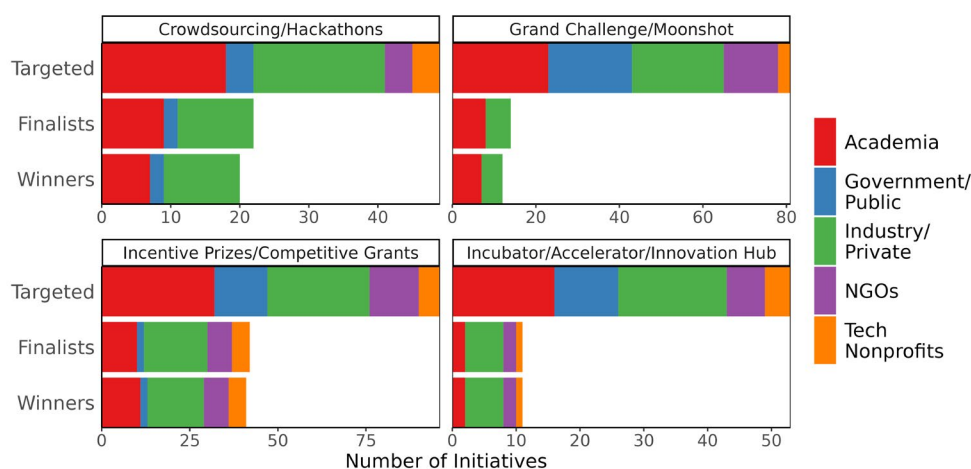


FIGURE 4.7 Progression of participants through the stages of the initiative, broken down by initiative type and participant type. The x-axis refers to the number of initiatives that had participants of a certain type (stacked).

BREAKDOWNS OF PARTICIPANT TYPE IN DIFFERENT CHALLENGE STAGES

We examine the progress of different groups of participants through different stages of Grand Challenges and open innovation initiatives. Interestingly, we see a significant narrowing of participant diversity as initiatives progress (Figure 4.7); early stages often see a broad mix of participants, but winners are predominantly from industry/the private sector or academia. For example, for incubators, the academic presence narrows and becomes almost non-existent as the program progresses towards its final stages, where the focus shifts more towards market readiness and scaling of business operations. The trend is particularly pronounced in Grand Challenges, where despite a diverse initial pool, the final winners are almost exclusively from industry/the private sector or academia. Stakeholders interviewed identified several factors that may play a role here: (1) academia and industry have greater access to computational resources and datasets essential to AI-driven climate solutions, giving them a competitive edge in Grand Challenges, (2) Challenge design and evaluation criteria that favor high-TRL solutions may inadvertently prioritize the technical contributions typical of these entities over the grassroots innovation or community-driven approaches essential to climate action, (3) the focus of Challenges is often more aligned with the research strengths and development capabilities of academia and industry, and may be less conducive to the unique, localized, impact-driven contributions of NGOs and tech nonprofits, (4) a need for more targeted outreach and support, suggesting that the integration of robust support systems could encourage the sustained participation of a wide range of entities, leveraging the innovation and

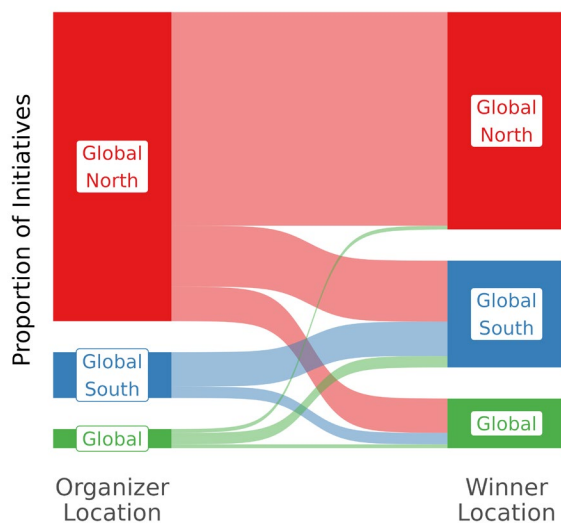


FIGURE 4.8 Geographical distribution of the initiative organizers (left) vs participants (right), as part of UNCTAD’s Global North vs. Global South categorization.

expertise available and needed to effectively address climate change. This severe underrepresentation of NGOs and tech nonprofits at the winning stage of Grand Challenges underscores the serious need for inclusive Challenge design and evaluation.

GEOGRAPHICAL DISTRIBUTION OF ORGANIZERS, PARTICIPANTS, AND FUNDING

We use UNCTAD’s Global North-Global South distinction³⁷ to assess the geographic diversity associated with the initiatives analyzed, in order to critically assess potential disparities and barriers to global accessibility. Roughly, Global North refers to developed economies, and Global South to developing economies.³⁸ Figure 4.8 shows the geographical origin of each initiative (or for fully virtual initiatives, the location of the organizing entity) vs. the distribution of participants. Note that for the organizers, the category “global” refers to entities that operate on a worldwide scale without being limited to or primarily associated with either the Global North or the Global South (e.g., Bill & Melinda Gates Foundation). For participants, it also includes the case where there are multiple winning (first) teams, including members both from the Global South and from the Global North. Our sample shows a significant dominance of initiatives organized by entities from the Global North, alongside a similar bias towards participants and winners from these regions, potentially suggesting an inherent advantage for participants from the Global North. Furthermore, Figure 4.9 shows a significant disparity: although the proportion of winners from the Global South is more than a quarter, they receive much less than a quarter of the funding. This disparity underscores the need for strategies aimed at increasing inclusivity and equity.

37 United Nations Conference on Trade and Development. (2023). Countries, all groups hierarchy. https://unctadstat.unctad.org/EN/Classifications/DimCountries_All_Hierarchy.pdf

38 United Nations Conference on Trade and Development. (2022). Handbook of statistics 2022. United Nations. <https://unctad.org/HandbookOfStatistics>

MODALITIES OF PARTICIPATION BY ORGANIZER LOCATION

Figure 4.10 shows the extent to which participation in these initiatives was in-person, online, or hybrid, offering potential insights into participation barriers. The data shows a great use of online platforms, mitigating some traditional barriers related to travel and physical presence. However, even with this notable use of digital media, hybrid models dominate, which incorporate elements of in-person engagement particularly in critical stages like convening and evaluation. Notably, no globally-focused initiatives are entirely held in person, which helps enable participation. In hybrid settings, however, participants online may still be put at a disadvantage over those able to attend in person, and participants may differ in their ability to afford attendance in person. There is a need not only to cultivate global participation, but also to design initiatives as platforms that inherently support and promote diversity, equity, and inclusion across axes such as geography. A potential way to address this is by having in-person events as close as possible to the locations of intended participants. •

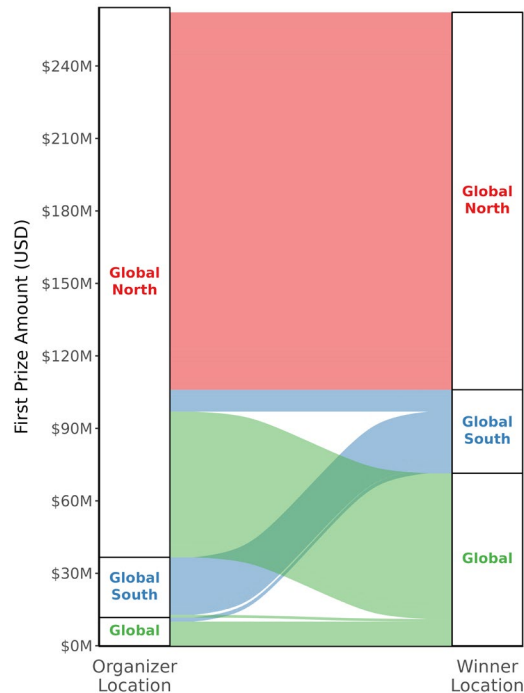


FIGURE 4.9 Funding distribution from source (organizers) to destination (winners), decomposed using the UNCTAD Global North vs. Global South categorization.

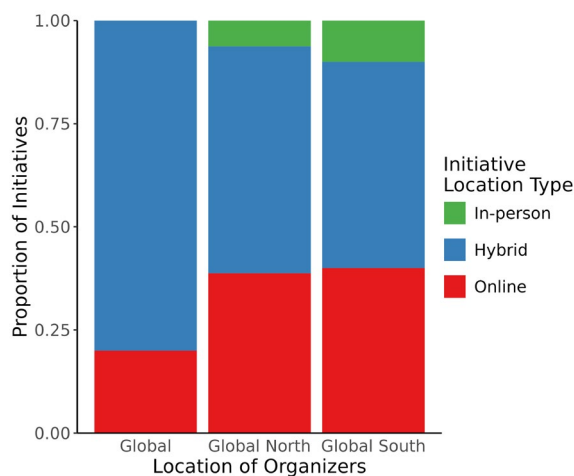


FIGURE 4.10 Modality for participation (in-person, online, or hybrid) between initiatives organized in (or by entities in) the Global North and Global South.

5. Leverage Points

Grand Challenges in AI for climate and nature aim to serve as catalysts for breakthroughs in innovative AI solutions to address major climate and nature challenges. Importantly, the benefits of these Challenges are not limited to the solutions developed during the course of the Challenge itself. Indeed, a fundamental role of a Challenge is in laying the foundations for further change^{39,40} — e.g., by fostering an ecosystem of cross-sectoral collaboration across academia, industry, governments, NGOs, and communities, and otherwise strengthening the stakeholder ecosystem; by driving further investments in R&D, commercialization, and public interest deployments; by building skills and capacity across global contexts; and by driving public awareness and policy change. In [Table 5.1](#), we offer a novel breakdown of the levers that Grand Challenges can use to drive systemic change, as well as examples of Grand Challenges and related open innovation initiatives that have espoused these levers in the context of their work.

Deciding which levers are of importance and defining a theory of change shapes the parameters that need to be established when designing a Grand Challenge, such as funding amount, technology readiness level, and objectives. [Table 5.2](#) provides a detailed breakdown of the different “archetypes” of Grand Challenges and open innovation initiatives identified in our analysis, each of which supports different theories of change. The nomenclature for these archetypes was conceptualized to succinctly encapsulate and distinguish the strategic orientations observed across different initiatives. From the “Discover & Disseminate” model, which targets early-stage ideation and knowledge dissemination, to the “Scale-Up” archetype, which propels near-market solutions toward widespread adoption, each archetype offers levers of change aligning with specific technology readiness levels and systemic impacts. See also [Figure E.1](#) in executive summary for a visual summary of the results in [Tables 5.1](#) and [5.2](#). •

39 Peña, V., & Stokes, C. A. (2019). Use of Grand Challenges in the Federal Government (p. 41). Institute for Defense Analyses.

40 McKinsey & Company (2009). “And the winner is ...”: Capturing the promise of philanthropic prizes.

TABLE 5.1 LEVERS FOR IMPACT

Levers for impact and systemic change exhibited by Grand Challenges and open innovation initiatives in our sample

LEVER FOR IMPACT	COMPONENT	EXAMPLES
Climate and nature outcomes	Climate change mitigation: Reduce greenhouse gas (GHG) emissions	XPRIZE Carbon Removal ⁴¹
	Climate change adaptation: Improve the ability of communities and natural systems to adapt to climate change impacts	AI for Climate Resilience in Rural Areas ⁴²
	Ecosystem services: Preserve or strengthen the benefits provided to humans by the natural environment and healthy ecosystems	African Agriculture Climate Adaptation Research System ⁴³
	Biodiversity: Preserve or enhance biodiversity, or address risks to threatened species	NASA's Harmful Algal Bloom ML challenge ⁴⁴
	Climate equity, climate justice, and environmental justice: Improve the equity of climate and nature approaches	Grand Challenges Grants - University of Maryland ⁴⁵
AI advancement	Improvement on diverse performance characteristics: Improve algorithmic attributes such as robustness, interpretability, uncertainty quantification, and generalization	AI for Materials Discovery Grand Challenge ⁴⁶
	Efficient and accessible approaches: Improve data-efficiency, reduce computational requirements, and otherwise enable improved efficiency and greater accessibility of AI approaches.	AI for Numerical Weather Prediction ⁴⁷
	Responsible and ethical AI frameworks: Develop standards and/or best practices for responsible, ethical, and participatory design of AI approaches.	Responsible Artificial Intelligence for Climate Action in Africa ⁴⁸
Research	Interdisciplinary research: Foster research crossing traditional boundaries	MIT Energy & Climate Hack ⁴⁹
	R&D activities: Boost investment in sustainability and technology research	AI for Materials Discovery Grand Challenge ⁵⁰
Innovation ecosystem	Support for innovation ecosystems: Prioritize cross-sectoral collaboration, resource availability, and access to knowledge and expertise	Grand Challenges Canada + SAMRC ⁵¹
	Open data: Encourage further innovation by creating open-access data and other research infrastructure	Climate Change AI Innovation Grants ⁵²
Implementation and scaling	Scaling-oriented funding: Provide financial support for the scaling and deployment of climate solutions	Climate Action Accelerator ⁵³

41 <https://www.xprize.org/prizes/carbonremoval>

42 <https://scholarships.af/opportunity/ai-for-climate-resilience-in-rural-areas-challenge/>

43 <https://gcgh.grandchallenges.org/sites/default/files/files/african-agriculture-climate-adaptation-research-system-rfp.pdf>

44 <https://wildlabs.net/event/join-nasas-harmful-algal-bloom-ml-challenge-and-win-prizes>

45 <https://research.umd.edu/resources/funding-opportunities/grand-challenges-grants/about-grand-challenge-grants-program>

46 <https://aisingapore.org/technology/ai-for-materials-discovery-grand-challenge/>

47 <https://www.turing.ac.uk/research/research-projects/ai-numerical-weather-prediction-nwp-ai4nwp>

48 <https://ruforum.wordpress.com/2022/04/28/call-for-innovation-research-grants-onresponsible-artificial-intelligence-for-climate-action/>

49 <https://www.mitenergyhack.org/>

50 <https://aisingapore.org/technology/ai-for-materials-discovery-grand-challenge/>

51 <https://www.grandchallenges.ca/2023/climate-and-health-nominees/>

52 https://www.climatechange.ai/calls/innovation_grants

53 <https://climateactionaccelerator.org/>

LEVER FOR IMPACT	COMPONENT	EXAMPLES
Market dynamics and consumer behavior	Adoption of new technologies: Encourage emerging tech adoption	The Clean Energy Challenge ⁵⁴
	Consumer-driven demand pull: Create market pull for climate innovation acceleration	Scale For ClimateTech ⁵⁵
	Market incentives: Create incentives for sustainable company practices	Venture For ClimateTech ⁵⁶
Capacity- building	Resource allocation: Develop skills in underserved communities	Smart Farming Innovations ⁵⁷
	Lifelong learning programs: Promote continuous education and skill development	The Destination Earth (DestinE) project ⁵⁸
	Professional training: Equip workforce with green economy and AI skills	Solar Energy Innovators Program ⁵⁹
Community engagement and empowerment	Public education and awareness: Engage communities through education campaigns.	2030 Climate Challenge ⁶⁰
	Engaging local communities: Incorporate participatory local decision-making into project planning to contextualize solutions.	African Agriculture Climate Adaptation Research System ⁶¹
	Community data empowerment: Provide communities with tools for action and self-monitoring.	XPRIZE Rainforest ⁶²
Access, inclusion, and justice	Improve access: Ensure equitable access to necessary resources (e.g., clean energy access)	Empire Technology Prize ⁶³
	Inclusion in decision-making: Ensure diverse voices are able to shape societal decisions	Partnership on AI ⁶⁴
Policy and regulation	Supportive policy framework: Provide compelling evidence to craft supportive policies and highlight the need for regulatory flexibility	UN Climate Change's AI initiative, AI for Climate Resilience Innovation Challenge ⁶⁵
	International cooperation: Drive global action on climate solutions by creating momentum through incentives and international cooperation	Clean Energy Challenge ⁶⁶ EIT InnoEnergy ⁶⁷

54 <https://www.whatdesigncando.com/clean-energy-challenge-2/>

55 <https://forclimatetech.org/>

56 <https://forclimatetech.org/>

57 <https://gcgh.grandchallenges.org/challenge/smart-farming-innovations-small-scale-producers>

58 <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-infra-2024-tech-01-03>

59 <https://www.zintellect.com/Opportunity/Details/DOE-EERE-RPP-SETO-2019-2100>

60 <https://www.leverforchange.org/challenges/explore-challenges/2030-climate-challenge/>

61 <https://gcgh.grandchallenges.org/sites/default/files/files/african-agriculture-climate-adaptation-research-system-rfp.pdf>

62 <https://www.xprize.org/prizes/rainforest>

63 <https://thecleanfight.com/etp>

64 <https://partnershiponai.org/how-we-work/>

65 <https://unfccc.int/news/ai-for-climate-action-technology-mechanism-supports-transformational-climate-solutions>

66 <https://www.whatdesigncando.com/clean-energy-challenge-2/>

67 <https://www.innoenergy.com/for-innovators/open-call-for-sustainable-energy-solutions/>

TABLE 5.2 GRAND CHALLENGE ARCHETYPES

Grand Challenge archetypes and their associated funding amounts, choices of solution technological readiness level (TRL, see Box 2.1), objectives, and unique levers for impact. (Climate and nature outcomes and AI advancement are shared levers for impact across all Grand Challenges in AI for climate and nature, and are therefore omitted in the table below.) Each archetype represents a different theory of change for the Grand Challenge.

Discover & Disseminate — Ideation Engine & Knowledge Disseminator	
Theory of change	Lay foundations of research and disseminate knowledge
Characteristics	TRL Level: Low (1-3) – Total Funding Amount: Up to \$1M
Objectives	<ul style="list-style-type: none"> » Lay foundations of research and educational outreach with the objective to pave the way for new technological exploration and public knowledge enhancement. » Outcomes span foundational research to public seminars and scholarly exchange, aiming to stir academic interest and lay the groundwork for innovation.
Levers for Impact	<ul style="list-style-type: none"> » Research » Innovation ecosystem » Capacity-building
Examples	<ul style="list-style-type: none"> » Helmholtz Funding initiatives on AI and machine learning⁶⁸ » ClimateHack.AI⁶⁹
Innovation Forge — Innovator Builder & Ecosystem Incubator	
Theory of change	Develop innovative prototypes and nurture the innovation ecosystem
Characteristics	TRL Level: Mid (4-6) – Total Funding Amount: \$1M-\$5M
Objectives	<ul style="list-style-type: none"> » Development of innovative prototypes and nurturing of a conducive innovation ecosystem. » Additional focus on building networks, workshops, and funding streams that enhance the capacity for progressing toward market readiness.
Levers for Impact	<ul style="list-style-type: none"> » Innovation ecosystem » Research » Capacity-building
Examples	<ul style="list-style-type: none"> » MIT Climate Grand Challenges⁷⁰ » AI for Materials Discovery Grand Challenge⁷¹
Societal Shifts — Impact Amplifier & Community Transformer	
Theory of change	Promote market-ready solutions with community-level impact
Characteristics	TRL Level: High (7-9) – Total Funding Amount: \$5M-\$20M
Objectives	<ul style="list-style-type: none"> » Drives market-ready solutions and community-level applications, promoting robust entry into markets and fostering local empowerment and resilience. » Balance commercialization with local engagement and adaptation to induce community transformation and adoption.
Levers for Impact	<ul style="list-style-type: none"> » Community engagement and empowerment » Market dynamics and consumer behavior » Access, inclusion, and justice
Examples	<ul style="list-style-type: none"> » IBM Watson AI XPRIZE⁷² » AIM for Climate Grand Challenge⁷³

68 <https://www.helmholtz.de/en/newsroom/article/helmholtz-funds-19-ai-projects-to-solve-urgent-grand-challenges/>

69 <http://ClimateHack.AI>

70 <https://climategrandchallenges.mit.edu/>

71 <https://aisingapore.org/technology/ai-for-materials-discovery-grand-challenge/>

72 <https://www.xprize.org/prizes/artificial-intelligence>

73 <https://www.aimforclimate.org/>

Policy – Governance, Policy Influencer & Knowledge Disseminator	
Theory of change	Shape public policy and governance via actionable insights
Characteristics	TRL Level: Mid-High (5-8) – Total Funding Amount: \$1M-\$10M
Objectives	<ul style="list-style-type: none"> » Inform policy making and distribute knowledge with insights gleaned from mid to high TRL projects. » Assist policymakers, community leaders, and educators in shaping and enforcing regulations, and disseminate actionable knowledge.
Levers for Impact	<ul style="list-style-type: none"> » Policy and regulation » Capacity-building
Examples	<ul style="list-style-type: none"> » 2030 Climate Challenge⁷⁴ » AI against Toxic Clouds⁷⁵
Nexus Network – Ecosystem Creator/Incubator	
Theory of change	Create robust platforms for coordination and capacity-building
Characteristics	TRL Level: Any – Total Funding Amount: \$500K-\$10M
Objectives	<ul style="list-style-type: none"> » Create robust platforms for cross-organizational coordination, fostering innovation-friendly environments, and capacity-building networks. » Support work across all TRLs, being foundational to the growth and health of the broader innovation landscape.
Levers for Impact	<ul style="list-style-type: none"> » Innovation ecosystem » Access, inclusion, and justice » Community engagement and empowerment
Examples	<ul style="list-style-type: none"> » Sustainability and Digital Reality Manufacturing Challenge⁷⁶ » XPRIZE Rainforest⁷⁷
Resilience Rooted – Community Catalyst	
Theory of change	Foster grassroots social innovation targeting local community needs
Characteristics	TRL Level: Low-Mid (2-5) – Total Funding Amount: Up to \$2M
Objectives	<ul style="list-style-type: none"> » Promote grassroots social innovation and education specifically targeting local and community levels. » Nurture climate resilience within communities through direct engagement, behavioral shifts, and empowering local initiatives.
Levers for Impact	<ul style="list-style-type: none"> » Community engagement and empowerment » Capacity-building
Examples	<ul style="list-style-type: none"> » African Agriculture Climate Adaptation Research System⁷⁸ » Lacuna Fund⁷⁹
Scaling Up – Market Catalyst & Policy Influencer	
Theory of change	Enable industry transformation for large-scale deployment and adoption
Characteristics	TRL Level: High (7-9) – Total Funding Amount: \$10M-\$50M
Objectives	<ul style="list-style-type: none"> » Enable large-scale industry transformation through deployment of near-market solutions and shaping of policy for wider adoption. » Enable large-scale market and policy impacts driving climate-related ventures into sustainable industry standards.
Levers for Impact	<ul style="list-style-type: none"> » Market dynamics and consumer behavior » Policy and regulation » Implementation and scaling
Examples	<ul style="list-style-type: none"> » Sustainable Aviation Fuel Grand Challenge⁸⁰ » Clean Energy Challenge⁸¹

74 <https://www.leverforchange.org/challenges/explore-challenges/2030-climate-challenge/>

75 <https://www.fruitpunch.ai/challenges/ai-against-toxic-clouds>

76 <https://hexagon.com/company/newsroom/press-releases/2023/hexagons-sixth-sense-calls-on-startups-to-apply-to-sustainability-and-digital-reality-manufacturing-challenge>

77 <https://www.xprize.org/prizes/rainforest>

78 <https://gcgh.grandchallenges.org/sites/default/files/files/african-agriculture-climate-adaptation-research-system-rfp.pdf>

79 <https://lacunafund.org>

80 <https://www.energy.gov/eere/bioenergy/sustainable-aviation-fuel-grand-challenge>

81 <https://www.whatdesigncando.com/clean-energy-challenge-2/>

6. Anatomy of a Grand Challenge

Based on our analysis of Grand Challenges and open innovation initiatives in AI and AI for Climate and Nature (100 and 115, respectively), this section details the major components of a Grand Challenge, as well as the key questions that need to be addressed when designing these components, across multiple categories namely: organizing entities, problem choice, initiative planning, outreach & target audience, challenge design, supporting aspects, and learning and adaptation mechanisms. We provide further details/insight on a number of the questions below in [Section 7: Strategic Recommendations](#).

TABLE 6.1 GRAND CHALLENGE COMPONENTS AND DESIGN CONSIDERATIONS

ORGANIZING ENTITIES	
Host organization	Who and what types of entities serve as the primary organizer(s) or host(s) for a Grand Challenge? Do they include governmental bodies, philanthropic organizations, non-profit organizations, academic institutions, private sector and for-profit entities, and/or a collaborative partnership among various types of stakeholders?
Sponsor/funder(s)	Who are the key sponsors backing the Challenge, and how will the involvement of these sponsors/funders determine the Challenge's outreach, process, and outcomes?
Implementation contractors/vendors	Is there a need for implementation contractors/vendors? What are the key factors in selecting them to support specific aspects of the Challenge, and who are the potential candidates?
Partners	Which partners should be chosen to amplify the Challenge's ability to meet its objectives around innovation, implementation, equity, and breadth of engagement? What resources or perspectives (e.g., mentorship/network, technical resources, visibility, implementation support, or improved accessibility and inclusion) can these partners provide? (See Sections 7.2 and 7.8 for further details.)
Government	Is there government support or interest in the Challenge? What regulation does the Challenge need to comply with? Can regulatory sandboxes be instantiated if compliance cannot be guaranteed? How are outcomes of the Challenge communicated to the government to maximize long-term impact? (See Sections 7.1 and 7.7 for further details.)
Affected stakeholders	Who are the individuals, communities, and ecosystems directly affected by the outcomes of the Grand Challenge? How can they be meaningfully involved in the design, implementation, and evaluation of the challenge to ensure that their needs and perspectives are valued and taken into account? How can they play an active role (e.g., as judges, participants, partners, observers, or evaluators)?

PROBLEM CHOICE	
Is the problem a critical gap to achieving climate/nature goals, and can it be meaningfully addressed using AI?	
Is a Grand Challenge the right instrument to unlock impact related to this problem, given the particular value proposition of a Grand Challenge (compared to other funding instruments) and relevant problem attributes (e.g., TRL, innovation landscape, adoption landscape)?	
Which areas of AI and climate/nature are saturated, and which ones are not? What are the specific areas and use cases that past Grand Challenges have already focused on?	
Is the timeframe of the Challenge appropriate for addressing the problem?	
What type of team would be expected to successfully participate in addressing this problem, and is it realistic that such stakeholders would participate?	
INITIATIVE PLANNING	
Goal/target/problem statement	How can the problem statement be defined in such a way to align with the focus area identified, attract the “right” participants, and guide the Challenge’s strategic objectives?
Theory of change	What is the theory of change of the Challenge with respect to driving broader systemic impacts? (See Section 5.)
Resources - total amount (USD)	<ul style="list-style-type: none"> • What amount of funding would be meaningful to unlock innovation in the specific area/problem? • Were additional costs introduced after the initial pre-launch budgeting?
OUTREACH & TARGET AUDIENCE	
Target audience & target geography	<ul style="list-style-type: none"> • What types of individuals and entities should be targeted for participation, given Challenge goals around focus area and breadth of engagement? • Should the outreach be open or by selection/invitation? • Should the initiative be a small group of hand-picked teams/collaborations, or a massive community initiative?
Eligibility criteria	Are there eligibility criteria for participation? How do they shape the diversity and capacity-building of the participating teams?
Communication strategy	How can outreach be designed more effectively, equitably, and inclusively? Are there any opportunities to partner with community-based networks?
CHALLENGE DESIGN	
Modality	Should the Challenge be online, in-person, or both (hybrid)?
Phases/Stages	How should the Challenge be designed? Is it in stages or a single sprint? Are there any temporal conditions on these stages? Are there specific timelines from design to announcement to disbursement?
Submission types	What types of submissions/solutions (proposals, prototypes, software, hardware, best practices, etc.) are sought?
Expert advisory board/judging panel	What roles do the judges and the expert advisory board play in aligning the Grand Challenge with its strategic objectives and in evaluating participant submissions?
Monetary incentives	<ul style="list-style-type: none"> • How much funding should be allocated per person/team vs. total funding? • Should the funds be disbursed in smaller or larger amounts? What funding is available to the winner(s)?
Non-monetary incentives	What non-monetary incentives can encourage and align participation (e.g., access to data, facilities, tools; demonstration opportunities; exposure to experts/influencers; regulatory relief/fast track; or publicity)?

Outcomes	<ul style="list-style-type: none"> • What solution types were produced and evaluated, and was the challenge outcome achieved? What factors (may have) influenced the results (e.g., technical or logistical) ? • What are the identities and types of organizations or individuals that reached the final stages of and/or won the challenge? • What unforeseen impacts, positive or negative, were illuminated through the challenge? Were there any unexpected partnerships, technological breakthroughs, or shifts that occurred, and how did these influence the outcomes of the Challenge?
SUPPORTING ASPECTS	
Data sources	Are there any data sources and/or simulators that need to be prepared for participants to use? Are these open or private? In the latter case, how can access be facilitated?
Support resources	What types of support resources (e.g., computing, mentoring) are provided to participants, and how are these resources tailored to maximize impact and build the capacity of the participating organizations to sustain themselves after the Challenge?
IP management	How will intellectual property rights be handled for the solutions generated?
DEI and ethics	Are there any DEI frameworks or principles to adopt? Are there ethical AI guidelines, climate equity frameworks, or other responsible innovation frameworks that should be adopted? (See also Section 7.8.)
Post-Challenge plans	Are there any follow-on plans for development, implementation, or deployment to support participants' solutions and their position within the ecosystem as a whole?
POST-CHALLENGE PLANS	
Feedback mechanisms	How are feedback mechanisms designed and implemented to capture insights from different stakeholders during and after the challenge?
Adjustment strategies	How is the feedback used for refinement between stages and for future iterations?

7. Strategic Recommendations

Strategic recommendations were developed based on the above analysis of existing Grand Challenges, aspects that were raised in the stakeholder interviews, and the questions identified in defining the anatomy of a Grand Challenge (Section 6, Appendix D.1). Recommendations were grouped into eight common themes: Problem choice, infrastructure, project teams, funding, stages, deliverables, evaluation, and diversity and equity. While these recommendations are specifically designed with Grand Challenges in AI for climate and nature in mind, a number of recommendations may also translate to other topic areas or initiative types.

7.1 PROBLEM CHOICE

Among high-impact problems, which ones are well-suited to be enabled by a Grand Challenge as opposed to other funding instruments?

When picking problems to prioritize in a Grand Challenge, it can be tempting to simply pick problem areas that are perceived as the “most important” – e.g., for a Grand Challenge on AI for climate and nature, the highest leverage areas for AI in addressing the climate and nature crises. However, such an approach misses the critical fact that just because an area of work is important, that does not mean a Grand Challenge in that area will have meaningful impact. In some cases, the area of work may not be at the appropriate level of technology or adoption readiness to be primed or accelerated by a Grand Challenge, and other funding instruments may be needed instead. If funding in a given area of work is already saturated, it may also be a lower priority for additional funding. In this section, we analyze how to take such points into consideration when designing a Grand Challenge.

Summary of recommendations

Amidst a variety of potentially impactful areas on which a Grand Challenge may focus, we provide pointers for how to prioritize these problems based not merely on the impact of the problem, but on how well-positioned a Grand Challenge is to unlock that impact. Application areas for AI vary greatly in Technological Readiness Levels (TRLs) as well as in readiness for widespread societal adoption. These factors are essential in determining the exact goals and deliverables of a Grand Challenge in a way that addresses the specific bottlenecks (technological or societal) holding back advancement. We also advise prioritizing problems where there is strong existing interest from complementary stakeholder communities to enable impact, but where limited

funding or media attention is holding back that impact. Overall, we emphasize that Grand Challenges should be carefully chosen to only address problems that are well-suited for AI, and not attempt to cover all topic areas “equally,” since some areas will naturally have a greater concentration of impactful, underserved problems.

Recommendations

» **FRAME GRAND CHALLENGE GOALS BASED ON READINESS LEVELS.**

Applications of AI to climate and nature vary greatly in terms of technological readiness level (TRL). Grand Challenges can be relevant at low, medium, or high TRLs (see our analysis in [Table 5.2](#)) but the intended impact of the Grand Challenge should be scoped to the gap that exists. For areas at a low TRL (such as AI for accelerated materials science), a Grand Challenge may be able to help drive initial investment and team-building, though direct impact is often further away. A famous example of this (outside AI for climate and nature) is the first DARPA Grand Challenge⁸² for autonomous vehicles, which kicked off considerable early-stage innovation in this area and laid the groundwork for a great deal of follow-on research and commercial ventures, even though effective autonomous vehicle algorithms took a long time to be developed. For areas at a medium TRL (such as AI for biodiversity monitoring), a Grand Challenge can catalyze rapid maturation in technology readiness, facilitate initial deployments, and help overcome “valleys of death” between promising initial research and scalable deployment. For areas at a high TRL (such as AI for electricity demand nowcasting in power systems), market-driven commercialization is often sufficient to drive further technological advancement, though as described below, there can still be a role for Grand Challenges in driving wider adoption.

Readiness for a new technology is not only measured by the TRL (how advanced the technology is) but also by measures such as the Adoption Readiness Level (ARL), Market Readiness Level (MRL), and Sociotechnical Readiness Level (SRL) (see [Box 2.1](#)), which assess how ready society is to adopt that technology, incorporating components such as infrastructure and data availability, market incentives, and key stakeholders’ receptivity. Instead of (or in addition to) focusing on TRL advancement, some Grand Challenges aim to tackle bottlenecks to adoption. For example, in areas such as AI for controlling electrical grids or other safety-critical systems, the critical bottleneck in practice is often a lack of trustworthy simulation infrastructure to develop and evaluate algorithms. In such an area, one may therefore design a Grand Challenge to focus on creating such infrastructure, rather than directly building the AI algorithms themselves. In such cases, it may be worth reassessing what a “solution” entails - and sometimes aiming for advancements that are sociotechnical instead of purely algorithmic. As an example, the AIM For Climate Grand Challenge⁸³ assesses in its evaluation criteria not only the technical viability of a solution but whether it is acceptable according to the needs and values of the society it aims to benefit.

» **ENSURE AI IS INDEED WELL-SUITED FOR THE PROBLEM.** AI and machine learning methods offer powerful tools for solving certain problems, such as prediction in settings with large datasets, but they are not applicable everywhere. For example, forecasting with long time horizons may not fulfill the stationarity requirements needed for pure data-driven machine learning methods. At the same time, even where AI may offer a feasible approach from a technical perspective, it may possibly still serve

82 <https://www.darpa.mil/about-us/timeline/-grand-challenge-for-autonomous-vehicles>

83 <https://www.aimforclimate.org/>

as a diversion or distraction from other effective (non-AI) climate and nature approaches. When designing a Grand Challenge in AI for climate and nature, it is important to be mindful about whether scarce attention and resources should indeed be directed towards AI specifically as the method to address this particular problem (see also Section 1).

- » **PRIORITIZE AREAS WITH EXISTING INTEREST FROM COMPLEMENTARY STAKEHOLDER COMMUNITIES.** Impact in AI-for-climate/nature applications requires engagement from multiple different stakeholder communities. For example, meaningfully addressing a biodiversity monitoring problem may involve researchers in AI, researchers in ecology, conservation organizations involved in on-the-ground efforts, and regulators, among others. Grand Challenge designers should ensure there is a critical mass of individuals or organizations across these various communities that are already interested in the relevant problem area, even if their work is not yet mature. Especially given the relatively short time-frame of a typical Grand Challenge, it is important that there are stakeholders who are able to come together and hit the ground running. As a rule, the greater the variety of organizations that want to explore an area of innovation, the more impact the Grand Challenge can have. For example, the AIM for Climate challenge focused on the intersection of agriculture and climate action. This Grand Challenge was highly successful in catalyzing impact because it brought together different stakeholder communities with strong existing interest in climate-smart agriculture and food systems, as well as concentrated on problems that were not already saturated (see the following recommendation).
- » **DEPRIORITIZE AREAS WITH DISPROPORTIONATELY HIGH FUNDING AND MEDIA ATTENTION.** In some sense, this represents the flip side of the previous recommendation. If an area of work is so well-known that it already receives considerable investment and media attention, then a Grand Challenge may be less effective. This is because some of the primary impacts of a Grand Challenge involve (a) increased visibility and (b) injections of funding in up-and-coming work. Some areas of AI for climate and nature are already relatively saturated in this respect. For example, the two examples previously given of accelerated materials science and nowcasting for power systems are, in general, quite well-funded and highly visible at the moment (even though one is at an early TRL while the other is at a late TRL). Thus, both of these areas should likely be deprioritized in Grand Challenge design. It is also often worth avoiding use cases that recent Grand Challenges have focused on effectively, though sometimes in cases where a previous Challenge was poorly scoped or executed, or where a new Challenge can “pick up” where a previous Challenge left off, an additional Challenge could have significant impact.
- » **DO NOT ATTEMPT TO COVER ALL AREAS EQUALLY.** While it may be beneficial in a suite of Grand Challenges to feature a range of applications of AI, different application areas should not necessarily be covered equally. For example, the power systems and agriculture sectors offer a multitude of highly impactful applications for AI. Other areas, such as carbon capture or climate-related education, are essential components of climate action, but have fewer high-leverage applications of AI. It is therefore fitting if more Grand Challenges in AI for climate and nature focus on power systems than on carbon capture. In such cases, a disparity should be seen as reflecting the abundance of impactful opportunities for AI in one domain rather than a gap that should be filled in the other.

7.2 INFRASTRUCTURE, SUPPORT, AND RESOURCES

What accompanying infrastructure, support, and resources are necessary to unlock impact during and after the Grand Challenge?

Prize money is often the most visible resource and incentive provided by a Grand Challenge. However, prize money alone may be insufficient to enable the development of compelling solutions and lay the groundwork for downstream impact. Gaps in cross-functional skills, infrastructure access, and support networks may impede participants' ability to impactfully develop, deploy, and sustain solutions, with different gaps faced by different stakeholder groups across academia, startups, established companies, and NGOs. The strategic provision of relevant non-monetary resources can help better equip participants with relevant skills, mitigate gaps in access to technology and other critical infrastructure, foster the building of well-rounded teams and cross-functional support networks, and promote the sustainability and longevity of solutions and the organizations behind them (e.g., avoid "valleys of death"). These resources may also serve as additional incentives for participation and therefore may help attract a wider range of talent to the Challenge. Planning for the provision of such resources can also provide an opportunity to bring additional strategic partners into the Challenge, who can both directly lend some of these resources and also otherwise amplify the Challenge's impact.

Summary of recommendations

We recommend the integration of non-monetary infrastructure, support, and resources within the Challenge design to strengthen pre-Challenge preparation, in-Challenge capacity, and post-Challenge implementation. These elements are essential in AI-for-climate/nature applications given the multifaceted nature of each such project and the many kinds of capacity and resources needed for long-term success. Such support may be provided directly by the Challenge organizer or may alternatively be provided by strategic partners. Relevant support may include training and workshops, mentorship (e.g., technical, business, and legal), technology access (e.g., to high-performance computing resources, specialized software tools, proprietary datasets, and unique prototype development facilities), and visibility for participants. Importantly, such support should be tailored to the unique needs of different participant groups, and potentially include a combination of technical support, business development support, legal support, and market strategy support. (In Section 7.3, we provide related recommendations related to team composition.)

Recommendations

- » **FACILITATE PRE-CHALLENGE TRAINING:** Before the Challenge officially begins, it is important to lay a solid foundation for participants to avoid early technical hurdles, familiarize themselves with important sociotechnical context, and ensure strategic alignment with the goals of the Challenge. This can be achieved by providing informational resources such as background reports and market research documentation, as well as offering interactive webinars and FAQ sessions. Often participating teams in AI for climate and nature challenges will have imbalanced backgrounds - e.g. skewing towards AI and tech, towards a climate-related

research area, or towards a certain deployment-relevant entity. More hands-on approaches such as bootcamps, tailored technical upskilling sessions, and sector-specific discussions aimed at particular stakeholder groups may also be helpful to fill knowledge gaps. For example, the Data for Climate Action Challenge conducted pre-Challenge sessions to explain the datasets that participants would be using, in order to set clear expectations and mitigate technical hurdles.

» **IMPLEMENT A MENTORSHIP PROGRAM:** Mentorship programs contribute significantly to bridging the gap between technical skills and practical application for participants. Challenge organizers should consider creating a structured mentorship framework that proactively matches participating teams with mentors who can provide targeted guidance on, e.g., specific technical challenges, product development, and/or business planning, as well as connections to relevant stakeholders. Key to this approach is ensuring that the matching process between mentors and teams is well-tuned to the specific needs and goals of each party, avoiding generic mentorship pairings that lack relevance to the team's project scope or fail to provide the specific expertise required. Mentorship should not be a one-size-fits-all approach but rather tailored to the unique challenges and objectives of each participant (e.g., via a mentorship application process where participants outline their project scope, desired outcomes, and specific requests for guidance), and ensure that there are clear expectations for the frequency and depth of interactions. Additionally, mentorship programs should not end abruptly with the Challenge but include post-Challenge support to avoid leaving teams without guidance during critical post-competition phases. Examples of mentorship programs include the Tunga AI Hackathon⁸⁴, which directly integrated machine learning experts into non-technical project teams; the XPRIZE Carbon Removal Challenge,⁸⁵ which provided mentorship support tailored to the specific development stages of the entrants' projects, potentially including engineering consultations, business mentorship for growth, and legal guidance; the BIND 4.0 startup accelerator,⁸⁶ which connects startups at different stages of development with established companies to enable visibility and collaboration; and the OceanHub Africa (OHA) Ocean Hackathon,⁸⁷ which awarded less than \$1K in prize money but used an extensive international network (1000 Ocean Startups) to help participants through strategic partnerships and mentorship.

» **FOSTER PEER-TO-PEER EXCHANGE:** Despite Challenges' competition-based nature, peer-to-peer exchange can play an important role in fostering group learning and thereby improving Challenge outcomes. For instance (in AI but outside the domain of climate and nature), the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) fostered an environment of continuous learning and feedback among their participant community of researchers, practitioners, and enthusiasts by providing online forums and discussion platforms where participants could interact, ask questions, share insights, and exchange ideas. ILSVRC also facilitated events where participants could receive feedback from peers and experts in the field. A major factor in the success of the Vesuvius Challenge (in which AI was used to reconstruct the text of historical manuscripts) was the allocation of funding awards for community collaboration, which incentivized the development of tools that were shared across teams. Such initiatives help to create an environment where researchers and practitioners can collaborate, learn from each other, and collectively drive continuous improvement in their work.

84 <https://tunga.io/ai-hackathon/>

85 <https://www.xprize.org/prizes/carbonremoval>

86 <https://bind40.com/>

87 <https://www.campusmer.fr/hackathon-2023-4222-0-0-0.html>

- » **FACILITATE ACCESS TO COMPUTATIONAL RESOURCES AND TECHNOLOGY SUPPORT:** Data, simulation environments, and computer hardware are critical in the development of AI-based solutions. However, computational resources such as large-scale GPU and TPU infrastructure (which is particularly useful for deep learning approaches) are often concentrated among select industrial entities, and cloud computing resources can be expensive, potentially impeding participation by teams from academia, startups, and NGOs, particularly in low- and middle-income countries. When developing and deploying AI in the context of climate and nature, many stakeholder groups fall naturally outside tech, exacerbating lack of access to such resources. The provision of computational resources, as well as necessary (potentially private) datasets and data storage capabilities, can help enable participation from a wider range of stakeholders and improve the quality of solutions. That said, it is important that computational resources provided for free during a Challenge do not “lock in” teams to high-cost payment plans for the same services when the Challenge is over; for this reason, computational resources provided during a Challenge should ideally be flexible and not require the use of one specific provider. In addition, given that many Challenges may be hardware-integrated or otherwise implemented on physical infrastructure, access to lab support or testbeds may also prove beneficial. For instance, the XPRIZE Carbon Removal Challenge⁸⁸ provided lab services for testing of carbon removal solutions.

- » **PROVIDE POST-CHALLENGE PUBLICITY FOR PARTICIPANTS AND THEIR SOLUTIONS:** After the Challenge has concluded, it is critical to implement strategies to ensure that the solutions developed during the Challenge continue to receive attention and recognition, as this increased visibility can be helpful for participants in securing necessary partnerships, funding, and other follow-on support. This may include leveraging digital platforms for regular project updates, success stories, and testimonials; securing media partnerships for ongoing coverage; and organizing showcase events at major industry events. Importantly, these publicity efforts should not only focus on the solutions developed during the competition, but can also serve to highlight and publicize the broader portfolio of work that participants have done prior to or alongside the Challenge. Prior challenges have spotlighted participants through targeted media coverage, social media promotion, and webinars (e.g., the AIM for Climate Grand Challenge⁸⁹), provided spotlights of participants during workshops and post-Challenge events (e.g., the Data for Climate Action Challenge⁹⁰ and Radiant Earth Challenges⁹¹), and provided recognition at high-profile events such as the UN Climate Change Conference (e.g., the Data for Climate Action Challenge).

- » **FACILITATE POST-CHALLENGE IMPLEMENTATION SUPPORT:** To enable the impactful implementation and scaling of solutions developed during a Grand Challenge, it is important to provide implementation support following the Challenge – either directly or by brokering connections to incubator-style programs. For instance, the IBM Watson AI XPRIZE⁹² integrated a structured visibility campaign alongside substantial incubation support (including business strategy advice, legal support, and facilitation of access to strategic partnerships and funding opportunities) in order to dramatically improve the trajectory of innovations. The Empire Technology Prize⁹³ might be considered as a hybrid of an accelerator and a Grand Challenge, offering advice on scalability and market entry. Organizers of the TED AI Hackathon⁹⁴ provided a \$25,000 SAFE Note investment to the

88 <https://www.xprize.org/prizes/carbonremoval>

89 <https://www.aimforclimate.org/>

90 <http://www.dataforclimateaction.org/>

91 <https://nasaharvest.org/>

92 <https://www.xprize.org/prizes/artificial-intelligence>

93 <https://thecleanfight.com/etp>

hackathon winner, aligning the longer-term incentives of the hackathon organizers with the success of the winner. Lever for Change⁹⁵ organizes a number of challenges, from which winners are invited to join the Bold Solutions Network offering support in project advancement.

- » **ESTABLISH PARTNERSHIPS WITH A RANGE OF ORGANIZATIONS EXPLICITLY TO SUPPORT PARTICIPANTS:** Partner organizations can provide essential non-monetary resources such as mentorship, workshops and training, computational resources, and access to private datasets. It is important that such partners encompass a range of organization types, especially given the interdisciplinary and diverse ecosystem around AI for climate and nature, including both high-profile organizations (which can lend prestige and exposure to teams that engage with them), as well as organizations across a diverse range of geographic and application-specific contexts (which can diversify perspectives, provide specialized expertise, and improve accessibility; see also Section 7.8).

7.3 PROJECT TEAMS

What is the best structure and composition for participating teams? How many teams should there be?

The process of selecting and structuring teams for participation in a Grand Challenge is complex yet critical, as it can have a direct impact on innovation, inclusiveness, and commitment. Grand Challenge organizers therefore face the important task of setting parameters that encourage participants to form cohesive, effective groups that are set up for success in the Challenge, including relevant interdisciplinary skills and expertise as well as incorporating a diverse range of perspectives.

Summary of recommendations

We recommend adopting a hybrid team selection process that combines open calls with hands-on organizer involvement in strengthening and diversifying teams. This aims to attract a broad talent pool, while ensuring that teams have the necessary commitment, skills, and multidisciplinary composition to deliver high-impact results. Based on the successes of past Challenges, this method has encouraged teams with a mix of backgrounds that leads to high-quality solutions, including those that persist beyond the timeframe of the Challenge. Teams should incorporate expertise across multiple lenses including both AI and relevant climate/nature topics, as well as diversity across other axes including geography, backgrounds, and skill sets.

Recommendations

- » **ADOPT A HYBRID APPROACH TO PARTICIPANT RECRUITMENT:** We recommend (1) starting with an open call to invite broad participation, followed by (2) hands-on organizer involvement in ways such as reaching out to potential additional teams with encouragement to join, helping existing teams fill gaps in expertise, or suggesting merging different teams

⁹⁴ <https://ai-event.ted.com/hackathon>

⁹⁵ <https://www.leverforchange.org/solutions/>

with complementary strengths. Both steps of the process can incorporate proactive outreach to stakeholders with relevant expertise, including those from traditionally marginalized and underrepresented communities (see also Section 7.8). For instance, the IBM Watson AI XPRIZE⁹⁶ started with an extensive open call, and then incorporated “wild card” entrants midway through the competition. This unique approach allowed for the inclusion of teams based on exceptional or innovative criteria that differed from the standard judging rounds. Notably, the ultimate winner of the competition was one of these “wild card” teams. Diversifying the set of teams can help ensure that varied innovations receive the spotlight, from university spin-offs presenting research-backed technologies to for-profits introducing market-ready solutions. Customization and selection can be done through preliminary assessments (e.g., building on tools such as Carrot’s Organizational Readiness Quizzes⁹⁷) and strategic team building (e.g., by proactively making matches among participants).

- » **ENCOURAGE AND GUIDE PARTICIPANTS TO FORM TEAMS ACROSS DISCIPLINES AND SECTORS.** Providing clear guidance to participants can enable the formation of teams with the relevant interdisciplinary skills and expertise (including, e.g., AI, domain-specific knowledge, and potentially implementation, project management, and communication). Organizers should facilitate forums towards the end of the initial application process where potential participants from different disciplines can connect and build well-rounded teams. It is also important to note that team complementarity extends beyond expertise and affiliation to include diversity in background and geography. The MIT Energy & Climate Hack⁹⁸ skill mapping for team formation can serve as an example of blending in-person and virtual participation, where while the hackathon was primarily held in-person at MIT, some participants were able to participate online as part of hybrid teams. The Water and Energy for Food Grand Challenge⁹⁹ prioritized regional diversity among innovators. The BIND 4.0 Acceleration Program¹⁰⁰ illustrates the value of precisely matching corporations with startups for practical, market-ready AI solutions that address real-world needs. By requiring startups to secure contracts with industry leaders as a condition of participation, the program ensures that emerging technologies are innovative and directly applicable to current market challenges.
- » **DO NOT BE OVERLY PRESCRIPTIVE IN TEAM REQUIREMENTS.** While it is important to provide guidance and suggestions for potential team formation, strictly defining “ideal” team compositions can inadvertently limit innovation.

7.4 FUNDING

How much funding is needed overall and at different stages of the Challenge to drive innovation, implementation, and supporting infrastructure?

Funding mechanisms within Grand Challenges have proven successful in motivating participation and innovation through monetary incentives and sponsorship models. However, the great diversity of projects in the space of AI for climate and nature raises the question of how much funding is needed to actually lower barriers and unlock innovation across different problems,

96 <https://www.xprize.org/prizes/artificial-intelligence>

97 <https://carrot.net/news/can-competitions-replace-traditional-rfps>

98 <https://www.mitenergyhack.org/>

99 <https://we4f.org/apply-ssea>

100 <https://bind40.com/>

and how it should be allocated. While this is a critical point in the Challenge design process, the specific allocation of funds across the different phases of a challenge - preparation, execution, and post-Challenge support - often remains undiscussed or is done on a case-by-case bidding model. This section answers the following questions: What is the optimal structure and level of funding required overall? How can funding strategies be optimized to not only initiate but also sustain innovation momentum throughout the lifecycle of a Challenge? And how can funding strategies be designed to not only catalyze progress during the Challenge, but also ensure the sustainable development and deployment of solutions downstream of the Challenge? While we provide examples of funding levels below and in [Section 4](#), given the diversity of problems in AI for climate and natural space, we cannot recommend specific funding ranges that are domain- and goal-agnostic.

Summary of recommendations

To maximize the impact of Challenge-driven innovation, we recommend using a tiered funding model that aligns with the lifecycle and maturity stages of innovation projects. A phased funding approach, aligned with clear innovation milestones, can maintain momentum and provide ongoing support for participants' projects. This includes a structured funding allocation plan that provides initial planning grants for ideation and concept development; milestone-based funding during the Challenge for progressing teams; and awards, grants, or investments for finalists and winners. We also recommend that a portion of the funding or support be pre-allocated to promising and potentially less-resourced projects along specific axes that can be given as prizes or special awards, in order to encourage novel ideas and broader participation.

Recommendations

- » **CLEARLY COMMUNICATE AT THE OUTSET HOW FUNDING IS ALLOCATED AT EACH STAGE OF THE CHALLENGE.** This establishes transparency and informs participants about the support available at various phases/milestones, ensuring they can plan their innovation pathway with financial sustainability in mind. For example, and specifically for the Grand Challenges in AI for climate and nature, initial planning grants typically range from \$10,000 to \$50,000 (USD) and are intended to encourage a broad range of submissions and support early-stage ideation and concept development. As projects progress, additional funding is often allocated based on the achievement of pre-determined milestones; funding at these milestones can vary widely, but typically ranges from \$100,000 to \$500,000, depending on the scope of the Challenge, the complexity of the projects, and the number of teams selected at each stage. Final prizes and special prizes can range from \$500,000 to \$1,000,000 and are designed to reward the most effective and impactful solution developed during the Challenge. See [Section 4](#) for more information on funding ranges and amounts for past Challenges.
- » **IMPLEMENT SEED FUNDING FOR EARLY-STAGE EXPLORATION.** Encourage broad participation by offering small initial planning grants to a large number teams selected in the first round for exploration, concept development, and ideation. This ensures a wider diversity of ideas and provides further incentives for teams to participate that may lack the

resources to compete without initial support. For example, the IMF Climate Innovation Challenge¹⁰¹ shortlisted 9 proposals and winning teams received up to \$50,000 in seed funding to further explore their ideas. The MIT Climate Grand Challenges¹⁰² allocated initial seed funding to kickstart projects with high-risk, high-reward outcomes. Another example is the Accelerating Catalyzing Solutions for Climate Change Grand Challenge,¹⁰³ which effectively provides seed funding for early-stage concepts, enabling projects to smoothly transition from ideation to prototype development.

- » **ADOPT A MILESTONE-BASED FUNDING STRUCTURE.** De-emphasize the “Grand” in “Grand Challenge,” by implementing a tiered or staggered funding model that disburses rewards based on the achievement of specific innovation milestones, rather than a lump sum at the end. This could include initial seed funding for concept development, followed by larger awards for prototyping, and a final payout for implementation-ready solutions. As seen in challenges such as the XPRIZE Carbon Removal,¹⁰⁴ where teams received funding upon reaching certain milestones, this method keeps participants engaged and financially supported, encouraging sustained innovation. This model ensures that teams are rewarded not only for their ideas, but also for their persistence and ability to evolve their projects (with flexibility on the timelines for achieving each milestone, given the diversity of participating teams’ structure and resources). Note that in many Grand Challenges, this iterative funding can and has been the majority of the total funding pool, i.e. the “grand” prize is only 10-20% of the prize pool (see also Section 4). A milestone based funding structure is particularly relevant in the presence of one of the following conditions: (1) the scope/area is too narrow and the pool of participants is not large, (2) the pool of potential participants is large, but many of them are working on a similar area and need to transition (e.g. from buildings to heating buildings) in a way that may be enabled by the financial incentives, or (3) the targeted pool of participants includes newly established startups and/or grassroots organizations and/or tech nonprofits. This is indeed critical to avoid a sprint-then-bankrupt phenomenon for participants.
- » **CONSIDER DESIGNATING SPECIAL AWARDS ALONG SPECIFIC PREDETERMINED AXES,** such as solutions from grassroots or community-based organizations, from women-led initiatives, with particular deployment readiness, leveraging untraditional resources, or on less popular but vital climate and nature issues, e.g. AI ethics or sustainability. These awards typically range from \$2,000 to \$100,000, in addition to seed funding, multi-tiered support, and the “Grand” prize. For instance, the BioMassters Challenge¹⁰⁵ implemented the MATLAB bonus prize, targeting open-source solutions. The Water and Energy for Food Grand Challenge¹⁰⁶ allocated special awards for projects demonstrating significant impact in their operational domains. Such special awards, while smaller than the grand prize, play a critical role in encouraging diverse and innovative entries that may complement or expand upon the Grand Challenge’s value proposition.
- » **CONSIDER FUNDING MECHANISMS FOR PARTICIPATION IN CHALLENGE EVENTS.** Consider funding mechanisms for participants’ engagement in networking events, conferences, or other Challenge-related events that would require participant travel. This was a significant challenge for participants in the IBM Watson XPrize,¹⁰⁷ where participants were required to attend international conferences without support from the funders. While feasible for well-resourced private sector participants,

101 <https://www.imf.org/en/Topics/innovation-at-the-imf/imf-climate-innovation-challenge>

102 <https://climategrandchallenges.mit.edu/>

103 <https://gcgh.grandchallenges.org/challenge/accelerating-catalyzing-solutions-climate-changes-impact-health-agriculture-and-gender>

104 <https://www.xprize.org/prizes/carbonremoval>

105 <https://www.drivendata.org/competitions/99/biomass-estimation/page/534/>

106 <https://we4f.org/apply-ssea>

107 <https://www.xprize.org/prizes/artificial-intelligence>

participation in these events was not as feasible for participants from less resourced organizations or communities.

- » **PLAN FOR POST-CHALLENGE SUPPORT AND VISIBILITY.** While Challenge organizers need not necessarily provide post-Challenge financial support, it is important that Challenge organizers facilitate continued mentorship, visibility, or connections with follow-on investment to enable post-Challenge implementation and deployment (see also Section 7.2) to provide, beyond mentorship, further opportunities for scaling, or support in finding additional investors. And these opportunities, including marketing, press releases, and showcases, can be costly. One example is the IBM Watson XPrize¹⁰⁸ providing post-challenge exposure, which was critical in the continued development and scaling of participating projects.

7.5 STAGES AND PROJECT EVALUATION

How should the Challenge be designed with regards to timing, stages, and project evaluation?

Once the focus area and overarching goals of a Grand Challenge have been determined, it remains to structure the Challenge for success in achieving those goals. The elements that occur in different phases of the Challenge, and their timing, are important in determining both how compelling it is to participants and how impactful the resulting solutions are. The criteria used for evaluating projects, and how these criteria are implemented, are also essential in shaping the nature and scale of impact, especially in the interdisciplinary area of AI for climate and nature. In this section, we consider how to shape these various factors for success.

Summary of recommendations

We recommend a phased structure for Grand Challenges, with a preliminary preparation phase (preceding launch) of 9-18 months; a submission and screening phase of 6-9 months; a core development phase focused on mentoring, prototyping, and pilot testing, of 12-18 months; and a final phase of iterative evaluation of 6-12 months. These phases should ideally be somewhat flexible to accommodate feedback and externalities. For the evaluation process, we recommend a mixture of quantitative and qualitative metrics oriented towards impactful deployment, and which are flexible enough to accommodate solutions across a range of problem settings. The panel of judges should include members with a range of complementary expertise, including deployment experts, and should avoid “celebrity” members.

Recommendations

- » **PHASES:** Grand Challenges typically span 2-5 years, divided into distinct phases. Based on our analysis of previous successful challenges/initiatives, we have the following general recommendations, which should be shaped

108 <https://www.xprize.org/prizes/artificial-intelligence>

by the Challenge's goals and intended impact pathways.

- » **Preparation and Launch Phase (9-18 months).** In this phase, the organizing team defines the exact scope, goals, eligibility criteria, evaluation metrics, engagement strategies, etc. for the Challenge. The timeline will vary depending on the desired duration of the challenge. Our research found that while some challenges have historically been planned in only 3-6 months, these were often perceived to be rushed.
- » **Submission and Initial Screening Phase (6-9 months).** For challenges targeting a broader range of topics, a longer timeframe may be necessary, while shorter timeframes may be considered if the pool of participants is closed (by invitation only), if the required documentation is brief (letter of intent or abstract), or if the focus area already aligns with a relatively well-developed topic. An example is the Empire Technology Prize,¹⁰⁹ where this step took over 6 months, even taking advantage of the fact that the solutions to be deployed already existed and were merely to be used in a different context.
- » **Mentoring and Development Phase (12-18 months).** It is critical to have a dedicated development phase, the exact form of which may depend on how projects are expected to advance in Technological Readiness Level (TRL). This phase should include mentorship, prototyping, and pilot testing, which are critical to refining climate and nature solutions for ultimate impact.
- » **Evaluation and Iteration Phase (6-12 months).** This phase should include multiple stages of evaluation with feedback loops for participants to refine their solutions and align them with the impact pathway, which is especially critical for solutions nearing deployment. Note that there may be a subsequent step for award ceremonies, recognition and awards, solution spotlighting, and discussion of future directions, although this step typically lasts only a few months.
- » **Allow for agile adaptation of the structure of the Grand Challenge.** Designing Grand Challenge phases with some flexibility allows for real-time adjustments in the structure based on feedback, emerging trends, and unanticipated needs. Adaptation can occur as a result of feedback from participants, outside experts, or potential users or as a result of contextual factors (e.g., as happened during the COVID-19 pandemic).
- » **EVALUATION METRICS:** The metrics used to evaluate projects at each stage will of course vary depending on the focus area of the Grand Challenge. We can however make the following recommendations for all Challenges in AI for climate and nature.
 - » **Evaluate climate and nature outcomes using established metrics.** The impact on climate change or nature problems should be front and center when evaluating projects, for example greenhouse gas emission reductions, energy savings, risks of damage to lives or property, ecosystem health, etc. Various metrics and frameworks on how projects can be evaluated.
 - » **Don't overfit to a narrow solution.** Ideally, the outcome of the

109 <https://thecleanfight.com/etp>

Challenge would not be a single “best” solution and a number of others that try to do the same thing but worse. By encouraging teams to be addressing a common core problem but doing so in different contexts, the Challenge encourages the solutions to be complementary and useful in different situations. Often, for example, in the climate and biodiversity crises, different geographic regions face slightly different challenges in a common problem. Metrics for success should therefore account for some variability in the emphases of the solution.

- » **Incentivize integration into existing systems.** This can avoid the common phenomenon where solutions that could be useful instead “sit on a shelf” because they fall outside of deployment entities’ standard processes (as may happen, e.g., in the case of standalone AI-powered tools for monitoring or optimization).
- » **Allow for low-tech options that solve the problem.** Evaluation metrics should be about achieving a certain outcome with respect to the climate and/or biodiversity crises, without making assumptions about exactly what technology will be used to get there. For example, in remote sensing, simple random forest algorithms have often outperformed sophisticated Transformer-based deep learning algorithms. In fact, simpler algorithms should if anything be preferred, since they are generally more accessible to a wide set of stakeholders.
- » **Assess technical characteristics necessary for deployment.** Depending on the problem, such characteristics may include robustness, interpretability, low computational costs of the machine learning model, etc. It is important to work with deployment entities early on to elicit context-specific requirements and nuances, since these will be highly application-dependent and often will not fall into typical AI definitions (e.g. notions of “robustness” vary greatly).
- » **Assess responsibility and ethics.** It is important to ensure that projects are practiced in a manner that is consistent with frameworks for responsible and ethical AI¹¹⁰ (covering considerations such as fairness, equity, accountability, trustworthiness, safety, privacy, security), equitable climate action (considering, e.g., climate equity, climate justice, and environmental justice¹¹¹), and meaningful stakeholder engagement and participatory design.^{112,113}
- » **JUDGES:** Grand Challenges typically use a panel of judges or reviewers to interpret and implement the chosen evaluation metrics, both quantitative and qualitative. While the composition of the judging panels can be made public or kept private, depending on the policy and nature of the Grand Challenge, we observe that the panels for the Grand Challenges in AI for climate have mostly been private, with a few exceptions such as those for the XPRIZE Rainforest¹¹⁴ and the XPRIZE Carbon Removal.¹¹⁵ The following principles are important in selecting judges.
 - » **Ensure complementarity of expertise.** Judging panels should include a mixture of AI experts and experts in the relevant domain within climate and nature, alongside individuals expert in the societal and ethical implications of the problem. Ideal judges also have some complementary familiarity outside their core expertise (e.g. an ecologist with experience in AI).

110 UNESCO (2021). Recommendation on the Ethics of Artificial Intelligence. Available at <https://unesdoc.unesco.org/ark:/48223/pf0000381137>.

111 Mah, Alice. “Environmental justice in the age of big data: Challenging toxic blind spots of voice, speed, and expertise.” *Environmental Sociology* 3, no. 2 (2017): 122-133.

112 Verma, A., & Allen, T. (2024). A sociotechnical readiness level framework for the development of advanced nuclear technologies. *arXiv preprint arXiv:2403.18204*.

113 Bondi, Elizabeth, Lily Xu, Diana Acosta-Navas, and Jackson A. Killian. “Envisioning communities: a participatory approach towards AI for social good.” In *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society*, pp. 425-436. 2021.

114 <https://www.xprize.org/prizes/rainforest>

115 <https://www.xprize.org/prizes/carbonremoval>

- » **Include representatives of deployment entities.** Such individuals can speak to the practicality of implementation, scaling, and impact for proposed solutions, while often being less centered on technical innovation for its own sake. Representatives of communities potentially impacted by the deployed solution may also be relevant.
- » **Avoid “celebrity judges.”** Figures whose appeal stems from their visibility or public image (including various famous figures in Big Tech) should generally be avoided in favor of ensuring the expertise and legitimacy of those on the judging panel.
- » **Ensure a diverse panel.** In addition to disciplinary and sectoral diversity, other axes of diversity such as gender, race, age, disability, geographical location, citizenship, political affiliation, sexual orientation, and socioeconomic status should be considered when choosing judges. This can be important in strengthening the perspectives of the judging panel, and thereby contributing to improved outcomes (see also Section 7.8).

7.6 DELIVERABLE TYPE AND INTELLECTUAL PROPERTY

What types of solutions should be sought and how will those solutions be managed?

Grand Challenges in AI for climate and nature can cover a broad range of deliverables, including proposals, scientific models, engineering prototypes, digital twins, and policy advice. No single solution type universally prevails; the key is aligning deliverables with Challenge objectives and ensuring their effective management post-Challenge. With AI, the difficulty often lies in ensuring incentives for innovation while advancing the innovation ecosystem as a whole and improving technology accessibility where it is most needed. The focus on climate and nature additionally requires the deliverables to translate innovations into actionable strategies for climate mitigation, adaptation, or protection of nature.

Summary of recommendations

Consider carefully what deliverable is most useful for deployment entities in the respective area of the Grand Challenge so as to maximize impact. Choose from a variety of solution formats not limited to software or hardware, or allow participants to choose. The TRL and adoption readiness that are envisioned for the solution should be a guiding criterion when choosing what form deliverables take. Aim for open-sourcing the results where possible, and where not, offer intellectual property (IP) protection and support that is customized to the challenge. Focus the IP management on achieving a tailored balance between providing spaces for sharing and scaling solutions through open source, while protecting the rights of creators and allowing for commercialization.

Recommendations

- » **TAILOR DELIVERABLES TO THE PROBLEM AT HAND.** Impactful solutions in the nature and climate space can vary dramatically, thus so may the

deliverables of Grand Challenges aiming to provide these solutions. In particular, in contrast to most AI challenges, a software demo may not always be suitable. Consider carefully what deliverable is needed by and useful for relevant deployment entities to maximize impact. For instance, policymakers may value understanding strategic trade-offs over an optimal risky single strategy. For example, the AI for Climate Resilience in Rural Areas Innovation Challenge¹¹⁶ requires AI-driven climate impact prediction models to aid policymakers with strategic planning. For power systems, the L2RPN Challenge¹¹⁷ seeks robust and interpretable AI models that ensure grid reliability beyond predictive accuracy. The Clean Energy Challenge¹¹⁸ prioritizes the development of market-ready products that consumers can use for renewable energy solutions. Similarly, allowing solutions to cover a variety of solution formats, rather than limiting submissions to software or hardware, can accelerate the potential for innovation. Some Grand Challenges do not prescribe a specific solution format at all: IBM Watson AI XPRIZE,¹¹⁹ for example, chose to focus on accelerating the development of AI to solve grand societal challenges with open-ended solution types. Similarly, the AI for Climate Resilience in Rural Areas Innovation Challenge¹²⁰ seeks diverse AI-driven solutions, such as models, tools, or strategies, to empower rural communities to adapt to climate change. The XPRIZE Carbon Removal¹²¹ also adopts an open-ended approach, calling for a range of technologies that can demonstrably remove carbon from the atmosphere across different pathways. As long as the judges have expertise in the relevant solution space and what proposed solutions will be useful, this flexible approach can be a good option.

» **THE TRL AND ADOPTION READINESS THAT ARE ENVISIONED FOR THE SOLUTION SHOULD GUIDE WHAT FORM THE DELIVERABLES TAKE**

(see Section 7.1). For early TRLs, for example, a scientific model or dataset may be an appropriate deliverable, while for later TRLs, robust software systems may be required. Where a demo is the deliverable, it should not be over-optimized to appear impressive for the narrow task of the Challenge; it must be robust and demonstrably useful beyond the context and data demonstrated in the Challenge.

» **ENCOURAGE AN OPEN SOURCE APPROACH TO SOFTWARE TOOLS, DATA, MODELS, AND ACADEMIC RESEARCH WHENEVER POSSIBLE, BALANCED WITH IP PROTECTION.**

Encouraging the use of open source licenses makes it easier to collaborate, improve data and models, and deploy solutions. Open source licenses, such as Creative Commons, MIT, and Apache, provide simple, legally permissive frameworks that minimize legal barriers. The TED AI For Good Hackathon¹²² is an example of an initiative that builds only on open source datasets to bypass issues with IP. However, open source may not be suitable in all cases, and IP protection and privacy measures may need to be in place. IP protection can motivate development in cases where commercialization is envisioned, as in the Solar Energy Innovators Program, where proprietary solar technologies were protected but shared under certain conditions to encourage innovation. For Challenges where open source data and models are not viable because of proprietary or sensitive information, the use of non-disclosure agreements (NDAs) and the adoption of robust privacy measures ensure the protection of sensitive information and technologies. For example, the Environmental Monitoring Innovation Challenge¹²³ used NDAs in addition to privacy frameworks.

» **PROVIDE CUSTOMIZED IP STRATEGIES,** including patent filings and exclusive licensing agreements, for Grand Challenges focused on

116 <https://scholarships.af/opportunity/ai-for-climate-resilience-in-rural-areas-challenge/>

117 <https://www.epri.com/l2rpn>

118 <https://www.whatdesigncando.com/clean-energy-challenge-2/>

119 <https://www.xprize.org/prizes/artificial-intelligence>

120 <https://scholarships.af/opportunity/ai-for-climate-resilience-in-rural-areas-challenge/>

121 <https://www.xprize.org/prizes/carbonremoval>

122 <https://www.ai-event.ted.com/hackathon>

123 <https://apply-for-innovation-funding.service.gov.uk/competition/1838/overview/8e7ae74c-af9d-4c8b-8bee-084865a57276>

methodological innovations or scaling up. For instance, BIND 4.0¹²⁴ facilitated direct negotiations between startups and corporations through live pitching sessions to promote commercialization and partnerships. This is particularly critical for technologies that require significant R&D, focusing on building connections between participants, corporate institutions, and venture capitalists rather than on direct investment or acquisition. These partnerships allowed participating teams to enter the challenge with their own proprietary technology and negotiate contracts that allowed them to deploy their products within these large corporations. This approach underscores the importance of having a clear IP strategy that protects the team's innovations while enabling partnerships that can lead to scaling and deployment of solutions. Challenges should provide participants with robust IP management support through workshops and legal advice to navigate these legal structures effectively. The MIT Energy & Climate Hack,¹²⁵ while being successful in its value proposition, underscored the need for accessible communication channels with judges or mentors for nuanced guidance on IP management, including the negotiation of relevant agreements. Tailored IP strategies depend on the solution types, and may include open source licenses, patents, and clearly-communicated IP policies that are Challenge-specific to protect participants' innovations while clarifying their rights post-Challenge. IBM Watson AI XPRIZE¹²⁶ encouraged international peer review for the IP policies and requirements, and implemented IP best practices from across the globe.

7.7 SUCCESS

How should the success of the overall program be evaluated?

While we have discussed the criteria that should be used to define the success of individual teams and projects within the Grand Challenge, a separate set of criteria should be used to evaluate the success of the Grand Challenge itself (see also [Section 5](#)). Such an evaluation is especially essential in a recurring Grand Challenge, where lessons learned from one iteration can be used to improve the next iteration. The Organisation for Economic Co-operation and Development (OECD) defines impact evaluation as an assessment of how the intervention being evaluated affects outcomes, whether these effects are intended or unintended. In this section we provide recommendations on considerations and potential approaches that can be adopted to support the evaluation of the impact of a Grand Challenge.

Summary of recommendations

Overall, it is important to adapt any framework used for evaluating the program to the particular theory of change that is espoused in its design. There are nonetheless some important considerations common across Grand Challenges in AI for climate and nature, which we detail. We recommend integrating both quantitative and qualitative measures of impacts on climate and nature, alongside assessment of the impacts on AI innovation. To assess the broader impacts of the Grand Challenge, we recommend evaluating the pathways to adoption for projects developed in the Challenge, as well as the long-term viability of project teams and any opportunity cost associated with individuals leaving prior projects to work on the Grand Challenge. These assessments should be supported by an expert-driven

¹²⁴ <https://bind40.com/>

¹²⁵ <https://www.mitenergyhack.org/>

¹²⁶ <https://www.xprize.org/prizes/artificial-intelligence>

monitoring and evaluation framework, that can be used to recalibrate strategies as needed based on project outcomes and impacts as well as changing exogenous factors.

Recommendations

- » **ALIGN THE EVALUATION FRAMEWORK TO THE SPECIFIC THEORY OF CHANGE OF THE GRAND CHALLENGE.** Useful frameworks for the evaluation of interventions have been developed e.g. by the OECD DAC Network on Development Evaluation.¹²⁷ Such frameworks must be specialized, however, to the particular nature of the intervention, and to the particular theory of change of the given Challenge. (Implicit in this recommendation the need to formulate a theory of change for the Grand Challenge, covering both direct outcomes and systemic impacts; see Section 5.) One Grand Challenge, for example, may aim to advance the technological readiness level of computer vision algorithms for biodiversity monitoring, while another may seek to advance the adoption and market readiness level of these same algorithms by establishing their market value within hardware systems in the field; in these two cases, despite the similarity in algorithms, the differences in these Challenges' theories of change may yield differing definitions of "impact." With that said, we detail several key recommendations below that will apply to most Grand Challenges in AI for climate and nature.
- » **ASSESS IMPACTS ON CLIMATE AND NATURE BOTH QUANTITATIVELY AND QUALITATIVELY.** A mixture of different metrics may be appropriate to assess the overall impact of the Grand Challenge depending on the problem domain, and no one should be used exclusively. For example, one may estimate the potential overall reduction in GHG emissions if a climate change mitigation solution were to be widely adopted. However, any such estimate comes with assumptions and uncertainty, and impacts may be even harder to quantify for non-GHG-related metrics such as climate resilience, preservation of ecosystem services, human wellbeing, and equity. This underscores the need to complement quantitative metrics with qualitative measures, in order to enable holistic assessment that does not inadvertently neglect important but hard(er)-to-quantify considerations.
- » **ASSESS IMPACTS ON AI INNOVATION.** Projects in AI for climate and nature have the potential not merely to address the climate and biodiversity crises, but also to advance AI innovation. For example, Fourier Neural Operators,¹²⁸ originally developed for weather modeling, have proven to be useful for numerous applications across society. It may therefore be worthwhile to include evaluation criteria assessing the impact on cross-cutting AI innovations, even if this may not be a primary goal for the Grand Challenge.
- » **CONSIDER THE LIKELIHOOD OF WIDESPREAD ADOPTION, INCLUDING IMPACTS ON THE STAKEHOLDER ECOSYSTEM.** There are two components here.
 - » First, consider the direct outcomes of projects: What signs are there that projects developed within the Grand Challenge will be integrated into deployed products and scaled? What interest in these projects has arisen from potential deployment partners, and are the projects well-scoped for integration into the existing ecosystem?

¹²⁷ <https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm>

¹²⁸ Li, Zongyi, Nikola Borislavov Kovachki, Kamyar Azizzadenesheli, Kaushik Bhattacharya, Andrew Stuart, and Anima Anandkumar. "Fourier Neural Operator for Parametric Partial Differential Equations." In *International Conference on Learning Representations*. 2021.

- » Second, what has been the broader impact on the innovation, deployment, and governance ecosystem in this area? Has the Grand Challenge fostered new collaborations between relevant private and public entities, influenced regulatory frameworks to support AI-driven climate solutions, grown the ecosystem of actors, or inspired funding mechanisms that will further advance projects in this area?
- » **CONSIDER THE LONG-TERM VIABILITY OF PROJECTS.** In order to be impactful, the coalitions and organizations supported by a Grand Challenge should persist and not collapse once the Challenge is complete. Indeed, all teams (not just the winners) should benefit from their involvement in the Grand Challenge. There is always the danger that, by injecting a large amount of funding with a short-term goal, a Grand Challenge can encourage unsustainable growth in participating organizations. Criteria for a Grand Challenge's success should incorporate sustainability assessments for participating organizations to ensure that the Challenge is incentivizing viable patterns of long-term organizational growth.
- » **ESTIMATE OPPORTUNITY COSTS ASSOCIATED WITH PARTICIPATION.** In addition to understanding the impacts of the projects directly enabled by a Grand Challenge, it is important to consider any unintentional secondary effects the Grand Challenge may have had on related work. In particular, did it draw capacity or funding away from other problems or projects? Many of the organizations and individuals who participate in a Grand Challenge in AI for climate and nature will likely have been working in similar areas already. The impact of the Challenge would ideally be compared against the impact that these individuals would have had if the Challenge had not occurred. Surveys or interviews with participants may help to estimate such effects. Responses can help to inform the design and problem scoping of future iterations of a Grand Challenge.
- » **DEVELOP A COMPREHENSIVE MONITORING AND FEEDBACK MECHANISM.** We recommend assembling a steering committee of domain experts in climate and nature, AI experts, grassroots leaders, market experts, and policymakers, alongside monitoring and evaluation (M&E) experts, to define success metrics that are both scientifically rigorous and societally meaningful. These metrics should be monitored via ongoing M&E systems, which include establishing data collection protocols for direct outcomes as well as frameworks for longitudinal studies to capture longer-term impacts.¹²⁹ In both the short- and long-term, M&E findings and recommendations should be used to inform decision making, refine strategies, and improve implementations. For instance, the climate and health-focused Wellcome Trust grants (e.g. Climate Impacts Awards¹³⁰, Heat adaptation¹³¹) bring together a steering committee of experts in epidemiology, AI, and policymaking to define their evaluation metrics, and uses a combination of manual and automated data collection systems to collect information on the immediate and longer-term impacts of their projects, as well as information about the changing scientific landscape.
- » **SHARE RESULTS.** Many of the challenges reviewed did not publicize the results of their assessments or the methodologies that were used to assess success. An important part of impact is information-sharing, thus allowing the sharing of learnings to improve the overall quality of Grand Challenges over time and encourage further sharing by other organizers in future.

129 Markiewicz, A. & Patrick, I. (2016). *Developing Monitoring and Evaluation Frameworks*, Thousand Oaks, CA: Sage. (See also downloadable framework template: <https://www.betterevaluation.org/tools-resources/developing-monitoring-evaluation-frameworks-framework-template>)

130 <https://wellcome.org/grant-funding/schemes/climate-impacts-awards>

131 <https://wellcome.org/grant-funding/schemes/heat-adaptation-evaluating-interventions-help-manage-health-effects-heat>

7.8 DIVERSITY AND EQUITY

What holds back diversity, equity, and meaningful community impact in practice, and how can those barriers be overcome?

The balance of projects and people in AI for climate and nature is not representative of society at large; the field reflects significant power imbalances and inequities in AI and tech more broadly. Improved equity represents not just a moral imperative, but also a strategic one: it empowers all parties in a Challenge to serve the needs of diverse stakeholders. This requires a targeted strategy to improve diversity and equity at every phase of a Grand Challenge, and more broadly in the innovation landscape of AI for climate and nature.

Summary of recommendations

We recommend establishing strategic partnerships with diverse community organizations so that they can participate from the ground up in designing the Challenge and outreach strategies. This can help guide the choice of Challenge problems to be more equitable and broadly relevant; ensure the Challenge is structured and designed in an inclusive and accessible manner; and enable recruitment of a broader and more diverse participant pool through joint networking and advertising support. It is also essential to establish diversity- and equity-focused goals, strategies, and targeted outreach to overcome barriers—financial, linguistic, administrative, computing access, teaming access, or experiential (such as being unable to access event proceedings due to technical limitations)—that might exclude potential participants. Explicit metrics for diversity, equity, and inclusion can help organizers understand and improve their degree of success at enabling impact for a diverse range of stakeholders and overcoming barriers to broad participation.

Recommendations

- » **PARTNER WITH COMMUNITY-BASED ORGANIZATIONS FOR CO-CREATION:** We recommend developing strong partnerships with organizations rooted in underserved or minoritized communities, such as ML Collective, Science for Africa Foundation, Data Science Africa, Khipu, and the Climate Collective Foundation. These organizations should be invited to participate in the design process as early as possible so they can contribute to ensuring that Challenge topics, structure, and outreach are relevant, inclusive, and reflective of local knowledge and cultural context. This approach emphasizes active collaboration over mere outreach, aiming to foster authentic co-ownership in addressing the challenges presented. An example of such collaboration is the Water and Energy for Food Grand Challenge, which leveraged partner insights to craft a gender-focused application template and scoring system to address specific community needs.
- » **CONSIDER A DISTRIBUTED LEADERSHIP STRUCTURE:** In some cases, it may be appropriate to adopt a distributed leadership infrastructure for the Challenge (made up of multiple organizations), rather than a solely centralized one. While a centralized leadership structure may be suitable for initiatives with a very targeted focus group (such as a competition focused on teams based in North America in a specific sector), if organizers aim to

expand and diversify the pool of participants (particularly geographically), a geographically distributed leadership structure can facilitate capacity-building, inclusive and culturally cognizant Challenge design and execution, and sharing of collective learnings.

» **DIVERSIFY PARTICIPATION VIA TARGETED OUTREACH:** An open call for participation rarely yields diversity; it is necessary to engage in active outreach as well. Organizers should perform desk research and interviews to find important networks to target in their outreach (which may include, e.g., conferences, affinity groups, email and/or social media groups, and newsletters). For example, Zindi¹³² is the largest professional network for data scientists in Africa, focused on solving African-centric problems through crowdsourced AI challenges, and is therefore a strong potential publicity partner to bring in participants from the continent. Similarly, partnering with organizations like AI4ALL¹³³ for targeted outreach can significantly increase diversity of participation by reaching young, underrepresented AI researchers early in their careers.

» **PROACTIVELY ADDRESS INCLUSION BARRIERS SUCH AS CONNECTIVITY AND LANGUAGE:** To make Challenges more accessible to participants from locations with slow Internet connectivity, organizers can provide resources in varying formats so that slower connectivity does not pose a barrier. This could include offering downloadable content in smaller, more manageable file sizes, using data centers in different global locations to improve content delivery, and providing versions of datasets that are smaller or more compressed, with the rationale that targeting a global audience means more than just promoting the Challenge or initiative broadly, but actually making it accessible to all.

Providing compute resources for both training and inference can help participants who lack access to such resources. Targeted mentorship throughout the application and Challenge process (see also Section 7.2), in addition to opportunities for logistical and/or financial support, can also facilitate continued engagement from a broader range of participants. For instance, projects such as ECMWF's Code for Earth¹³⁴ focused heavily on an ongoing mentorship model with participants that included regular consultations to improve the product and provide support. In addition, EU-based participants received additional financial support of up to 500 Euros to attend relevant conferences and events.

To address language barriers, organizers can provide Challenge materials in several key languages, or even offer translation services for spoken or written communication required of applicants or participants. In the Accelerating Catalyzing Solutions for Climate Change Challenge,¹³⁵ providing language support was instrumental in enabling broader participation. Measures included professional translation of proposals and key documents, strategic dissemination of Challenge information through local newsletters and social media channels in multiple languages, and public recognition of first-time grant recipients to encourage new entrants. These efforts were critical to building trust within local communities and ensuring that the Challenge reached innovators from a variety of linguistic backgrounds. As a result, 65% of Challenge participants were from low- and middle-income countries, recognizing a thorough and culturally sensitive approach to language support.

» **DON'T JUST BUILD FOR INCLUSIVITY; MEASURE AND LEARN:** Set explicit goals for diversity and equity, across indicators such as geographical location, gender, race, age, and socioeconomic status. Other

132 <https://zindi.africa/>

133 <https://ai-4-all.org/>

134 <https://codeforearth.ecmwf.int/>

135 <https://gcgh.grandchallenges.org/challenge/accelerating-catalyzing-solutions-climate-changes-impact-health-agriculture-and-gender>

indicators might include statistics about the size and funding level of participating organizations, number of academic vs. private sector vs. nonprofit participants, number of non-tech-focused team members, or number of first-time participants. The Vancouver Data Jam increased accountability by making their goals public, showcasing the Challenge's commitment to diversity and signaling to potential participants that their perspectives would be valued. Once diversity metrics are set, it is important to regularly review and report on them, as done by the Lacuna Fund¹³⁶ and the Indaba Grand Challenge,^{137,138} and to adjust outreach and support as needed. •

136 <https://lacunafund.org>

137 <https://deeplearningindaba.com/grand-challenges/leishmaniasis/>

138 <https://www.instadeep.com/2020/07/instadeep-key-driver-behind-initiative-praised-by-who-to-cure-leishmaniasis-disease/>

8. Conclusion

This report explores the role of Grand Challenges in the space of AI for climate and nature. Through a detailed analysis of more than 200 Grand Challenges and open innovation initiatives, we identify successes, pitfalls, leverage points, and value propositions associated with past initiatives, and offer key recommendations for improving the design, implementation, and impact of future Grand Challenges in this space.

Grand Challenges offer a unique mechanism for mobilizing significant resources around ambitious goals, and for catalyzing systemic change beyond immediate solutions (e.g., by creating market incentives and shaping policy frameworks). The success of a Grand Challenge, importantly, depends on careful problem selection, definition of a theory of change covering both direct outcomes and systemic impacts, and the thoughtful deployment of resources and support structures in alignment with this theory of change. We emphasize the importance of placing climate and nature goals at the center of Challenge design, execution, and evaluation, which critically includes consideration of deployability, long-term sustainability, ethics, equity, and community impact.

Drawing on learnings from past initiatives, we provide strategic recommendations that are intended to guide stakeholders in creating more effective and impactful Grand Challenges. In particular, we provide concrete guidance on choosing problem areas that are likely to benefit from a Grand Challenge; on combining monetary support with non-monetary resources such as mentorship, computing infrastructure, and post-Challenge support to improve solutions' impact and sustainability; and on parameters such as funding, phases, team selection and composition, deliverable type, and evaluation criteria. We particularly note that successful applications in the AI for climate and nature space involve a heterogeneous set of actors from a wide variety of sectors, contexts, and geographies, underscoring the importance of centering diversity, equity, and inclusion when shaping Challenge goals and supporting participation. As the intersection of AI and climate/nature continues to evolve, it is also imperative that future Grand Challenges not only address immediate technological needs, but also consider the broader systemic changes needed for sustainable development.

We hope that the insights and strategies outlined in this report help funders, organizers, and other stakeholders create more effective and inclusive Grand Challenges that drive meaningful progress on some of the most pressing issues of our time. However, many important questions remain on which we strongly encourage further work. These include: (1) Which specific AI-for-climate/nature problem areas should be prioritized in future Grand Challenges? (2) What metrics and frameworks should be used to assess the long-term environmental and societal impacts of solutions developed through Grand Challenges? (3) What are the socio-technical barriers to the adoption of Grand Challenge outputs (potential and/or realized) in different regions and sectors, and how can these barriers be overcome? We encourage further research by the community on these important questions. •

Appendices

A. OVERVIEW OF GRAND CHALLENGES IN AI FOR CLIMATE AND NATURE

Below, we list the Grand Challenges and open innovation initiatives in AI for climate and nature that were analyzed as part of this work.

NAME	CHALLENGE TYPE	GOAL	RESOURCES
2023 Call for Code Global Challenge	Crowdsourcing/ Hackathons	Develop open source solutions leveraging cloud, data, and AI that help communities adapt to and mitigate the impacts of climate change, with consideration for marginalized groups.	Challenge site FAQs on Participation
2030 Climate Challenge	Incentive Prizes/ Competitive Grants	Reduce US greenhouse gas emissions substantially by 2030 in the buildings, industry, and transportation sectors.	Challenge site FAQs
Accelerating Catalyzing Solutions for Climate Change's Impact on Health, Agriculture, and Gender	Grand Challenge/ Moonshot	Develop innovative, transdisciplinary approaches to adapt to, Mitigate, or reverse the combined negative effects of climate change on health, women's lives, and agriculture in sub-Saharan Africa, South Asia, and Brazil.	Grand Challenges FAQs
ADViCE (AI for Decarbonisation Virtual Centre of Excellence)	Incubator/ Accelerator/ Innovation Hub	Coordinate and enable collaboration between AI innovators and industry stakeholders across high-emitting sectors.	Challenge site FAQs
African Agriculture Climate Adaptation Research System	Grand Challenge/ Moonshot	Establish an integrated research system enabling African scientists to co-develop locally-relevant climate adaptation strategies with farmers that strengthen food and nutritional security across sub-Saharan Africa.	Grand Challenges FAQs
Agriculture-Vision and CropHarvest Challenges	Crowdsourcing/ Hackathons	Advance agricultural computer vision research through competitions focused on leaf counting and crop yield prediction using standardized datasets.	Challenge page FAQs
AI against Toxic Clouds	Crowdsourcing/ Hackathons	Develop computer vision solutions that automatically detect illegal toxic emissions from factories, enabling authorities to identify violations and enforce environmental regulations.	Challenge site FAQs
AI for agriculture, horticulture, water and food	Grants	Address key knowledge gaps inhibiting the development and adoption of artificial intelligence systems for sustainable food production and water management across the agriculture, horticulture and aquaculture sectors.	Challenge site Project proposa
AI for Climate Resilience in Rural Areas Innovation Challenge	Grand Challenge/ Moonshot	Develop ethical, AI-driven solutions that promote climate adaptation, resource management, and disaster preparedness in vulnerable rural communities globally.	Challenge site FAQs
AI for Climate Resilience Innovation Challenge	Incentive Prizes/ Competitive Grants	Accelerate the development of artificial intelligence and digital innovations that strengthen climate resilience and adaptation for vulnerable communities in low and middle income countries.	Challenge site FAQs
AI for Materials Discovery Grand Challenge	Grand Challenge/ Moonshot	Encourage the development of innovative approaches that assist scientists with efficient exploration of materials to generate high-potential candidates for advanced materials that are 50% lighter while retaining and/or enhancing their functional properties.	Challenge site FAQs
AI for Numerical Weather Prediction (NWP)	Grand Challenge/ Moonshot	Advance numerical weather prediction capabilities and build societal resilience to weather extremes by exploring and deploying artificial intelligence and machine learning techniques that complement physics-based forecasting models.	Challenge site FAQs
AI for the Planet	Incentive Prizes/ Competitive Grants	Accelerate the development and adoption of AI innovations that enable progress across the 17 UN Sustainable Development Goals, while also managing risks.	Challenge website FAQs
AI Innovation Grand Challenge	Grand Challenge/ Moonshot	Accelerate climate action in developing countries through artificial intelligence innovations that enhance adaptation and resilience.	Challenge site FAQs

NAME	CHALLENGE TYPE	GOAL	RESOURCES
AIM for Climate Grand Challenge	Grand Challenge/ Moonshot	Catalyse breakthrough AI innovations that help society rapidly mitigate, adapt, and build resilience to climate change while managing potential risks.	Challenge website FAQs
Artificial Intelligence for Decarbonisation Innovation Programme	Grand Challenge/ Moonshot	Accelerate the development and adoption of innovative AI technologies across industries that reduce carbon emissions and support the UK's transition to net zero.	Challenge site FAQs
BioMassters Challenge	Crowdsourcing/ Hackathons	Accurately estimate the annual above-ground biomass productivity of Finnish forests using remote sensing data to support sustainable forestry management.	Challenge page FAQs
Breakthrough Energy Catalyst	Incubator/ Accelerator/ Innovation Hub	Accelerate the deployment of four critical decarbonization technologies - direct air capture, green hydrogen, long duration storage, and sustainable aviation fuels - through innovative public-private financing models.	Challenge website FAQs
Catalyst Energy Innovation Prize	Incentive Prizes/ Competitive Grants	Accelerate the development of renewable energy and energy efficiency solutions by crowdsourcing market problems and enabling rapid business plan development through a series of contests with cash incentives.	Challenge website FAQs
City Learn Challenge	Incubator/ Accelerator/ Innovation Hub	Develop accurate machine learning models for forecasting and controlling energy consumption in a simulated neighborhood to enable generalized solutions for optimizing building energy usage at scale.	Challenge website FAQs
Clean Energy Challenge	Incentive Prizes/ Competitive Grants	Catalyze innovative product and service design concepts that accelerate the transition to renewable energy and make clean power more accessible across America.	Challenge site FAQs
Cleantech Open National	Incubator/ Accelerator/ Innovation Hub	Cleantech Open aims to find, fund, and foster cleantech entrepreneurs and startups, providing training, mentoring, visibility and access to capital to help launch and scale innovative companies addressing environmental challenges.	Challenge website Page
Climate Action Accelerator	Incubator/ Accelerator/ Innovation Hub	Empower organizations to reduce their environmental impact and accelerate climate action by providing technical expertise and solutions.	Challenge website FAQs
Climate Action Challenge	Incentive Prizes/ Competitive Grants	Combat climate change by calling on the creative community to submit innovative solutions that cut waste, cut emissions, and fight climate impacts.	Challenge website FAQs
Climate Change AI Innovation Grants program	Grants	Fund impactful research projects leveraging AI/machine learning to address climate change mitigation, adaptation, climate science, or related governance and impact assessment.	Challenge site FAQs
Climate Change and human health seed grants	Grants	Stimulate innovative interdisciplinary collaborations assessing and addressing the health impacts of climate change through early-stage funding supporting exploratory research and engagement.	Challenge site FAQs
Climate Impacts Awards	Grants	Support targeted, time-bound research and engagement activities that provide collaborative evidence enabling urgent climate action policies and decisions.	Challenge site FAQs
Climate Innovation Fund	Incubator/ Accelerator/ Innovation Hub	Accelerate technology development and deployment of new climate innovations through a \$1 billion investment initiative in the areas of carbon, water, waste, and ecosystems.	Challenge site FAQs
ClimateHack.AI	Crowdsourcing/ Hackathons	Catalyze climate action by mobilizing the AI community to collaboratively build open-source AI solutions that help address the climate crisis and advance the UN Sustainable Development Goals.	Challenge website Challenge Page
Code for Earth - ECMWF	Crowdsourcing/ Hackathons	Drive open source innovation in weather, climate, earth system science, and environmental monitoring by bringing together developers and domain experts in collaborative projects.	Challenge website FAQs
Cultural and creative industries for a sustainable climate transition	Incentive Prizes/ Competitive Grants	Enable Europe's cultural and creative industries to realize their potential to drive the sustainable climate transition by developing targeted support measures addressing their specific barriers.	Challenge site FAQs

NAME	CHALLENGE TYPE	GOAL	RESOURCES
DARPA Subterranean Challenge	Incentive Prizes/ Competitive Grants	Enable Europe's cultural and creative industries to realize their potential to drive the sustainable climate transition by developing targeted support measures addressing their specific barriers.	Challenge site FAQs
Data for Climate Action Challenge	Incentive Prizes/ Competitive Grants	Catalyze innovative public-private partnerships that leverage data science and AI to enhance climate resilience and sustainable development, especially in developing countries	Challenge website FAQs
Deloitte's Quantum Climate Challenge	Incentive Prizes/ Competitive Grants	Explore and demonstrate the potential of quantum computing to address pressing climate change issues by fostering collaboration between sustainability experts and quantum technologists.	Challenge site FAQs
Destination Earth (DestinE)	Grand Challenge/ Moonshot	Develop an extremely accurate digital model of Earth to simulate natural phenomena and human activities.	Challenge site FAQs
Development of Safe and Sustainable by Design Alternatives (IA)	Grants	Develop new substances and materials with improved sustainability that can safely replace chemicals of concern in industrial applications.	Challenge site FAQs
Elemental Exceleator	Incubator/ Accelerator/ Innovation Hub	Find, fund, and support growth-stage climate technology startups to help accelerate innovation and drive deep community impact.	Challenge website FAQs
Empire Technology Prize	Incentive Prizes/ Competitive Grants	Accelerate the development of innovative building heating technologies that significantly reduce greenhouse gas emissions from New York's tall buildings while being easy to adopt and cost competitive.	Challenge website FAQs
Energy Storage Capital Challenge	Incubator/ Accelerator/ Innovation Hub	Provide financing solutions and investment to help innovative or first-of-a-kind energy storage projects in New York State reach financial close.	Challenge website FAQs
Environmental Intelligence Grand Challenge (EIGC)	Crowdsourcing/ Hackathons	Develop innovative digital solutions that enable more effective monitoring, analysis, and action on urgent environmental threats like biodiversity loss and climate change.	Challenge website FAQs
Environmental Monitoring Innovation	Incentive Prizes/ Competitive Grants	Develop innovative technologies to enhance environmental monitoring capabilities and provide accessible, real-time environmental data to inform sustainability policies and responsible resource management.	Challenge site FAQs
ETCI 2021 Competition on Flood Detection	Incentive Prizes/ Competitive Grants	Advance flood detection capabilities using remote sensing data through a competition challenging teams to accurately classify satellite imagery pixels as flooded or non-flooded.	Challenge website FAQs
GENHACK 3 - HACKATHON FOR GENERATIVE MODELLING	Crowdsourcing/ Hackathons	Advance generative modeling capabilities for agricultural applications by enriching datasets and simulating future crop yields under climate change through an open innovation competition	Challenge site FAQs
GeoAI Challenge - AI for Good	Crowdsourcing/ Hackathons	Advance geographical artificial intelligence capabilities for social good by engaging global data science talent on real-world problems involving spatial mapping, disaster response, and location intelligence.	Challenge website FAQs
Google.org Impact Challenge on Climate Innovation	Incentive Prizes/ Competitive Grants	Use AI to help address social and environmental challenges.	Challenge site FAQs
Grand Challenge Research Initiative in Environmental Resilience and Sustainability	Grand Challenge/ Moonshot	Embed transdisciplinary research teams within Virginia communities to co-develop locally relevant solutions that enhance environmental resilience, sustainability, and climate justice	Challenge page FAQs
Grand Challenges Canada + South African Medical Research Council	Incentive Prizes/ Competitive Grants	Support the development, testing and transition-to-scale of integrated innovations that reduce the health impacts of climate change on vulnerable groups in low- and middle-income countries.	Challenge site FAQ

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Grand Challenges Grants - University of Maryland	Grand Challenge/ Moonshot	Mobilize cross-disciplinary teams at the University of Maryland to develop innovative solutions addressing the impacts of climate change on agriculture, disaster resilience, and environmental justice.	Challenge site FAQs
Grand Challenges: Addressing Climate Challenges for a Sustainable Earth	Grand Challenge/ Moonshot	Mobilize cross-disciplinary teams at the University of Maryland to develop innovative solutions addressing the impacts of climate change on agriculture, disaster resilience, and environmental justice.	Challenge website Challenge portal
GreenTech Innovation Competition	Incentive Prizes/ Competitive Grants	Promote the sustainability of digital technologies by using these technologies to measure sustainability.	Challenge site Project proposal
Heat adaptation	Grants	Develop, implement, and evaluate interventions that help vulnerable individuals and communities manage the health impacts of extreme heat events now and under climate change.	Challenge site Challenge portal
Helmholtz Funding initiatives on AI and machine learning	Grants	Advance artificial intelligence research and development through investments enabling transformative machine learning applications across diverse societal domains including healthcare, sustainability, education, and more.	Call Challenge site
Hi-tech capacities for crisis response and recovery after a natural-technological (NaTech) disaster	Incentive Prizes/ Competitive Grants	Develop innovative technologies and solutions to improve preparedness, response and recovery in case of crises triggered by natural hazards resulting in technological accidents.	Challenge site FAQ
IBM Watson AI XPRIZE	Incentive Prizes/ Competitive Grants	Accelerate the adoption of AI technologies for social good by sparking innovative demonstrations of human-AI collaboration that provide scalable solutions to address major global issues.	Challenge site FAQ
L2RPN Challenge (Learning to Run a Power Network)	Incentive Prizes/ Competitive Grants	Develop scalable reinforcement learning agents that can control power grid operations in real-time under uncertainty to prevent blackouts.	Challenge portal Challenge site
Lacuna Fund	Grants	Provide data scientists, researchers, and social entrepreneurs in low- and middle-income contexts globally with the resources they need to produce labeled datasets that address urgent problems in their communities.	Website
Land use change and local / regional climate	Grand Challenge/ Moonshot	Improve understanding of impacts of land use and land cover changes on local and regional climates to inform sustainable land management policies.	Challenge site Challenge website
Low-Carbon Resources Initiative (LCRI)	Incubator/ Accelerator/ Innovation Hub	Pursue research, development and demonstration of technologies that enable cost-effective decarbonization across the value chain of alternative energy carriers, including production, storage, delivery, and end use applications.	Challenge site FAQ
Manchester Prize for AI: energy, environment and infrastructure	Incentive Prizes/ Competitive Grants	Catalyze cutting-edge artificial intelligence innovations from UK teams that overcome key challenges in energy, environment, and infrastructure for public benefit.	Challenge site FAQs
Microsoft Climate Research Initiative	Grand Challenge/ Moonshot	Advance climate change understanding and model predictions through open partnerships between Microsoft researchers and earth systems scientists leveraging Azure computing capabilities.	Challenge site FAQ
Mission Possible Partnership (MPP)	Grand Challenge/ Moonshot	Accelerate the decarbonization of global industries representing 30% of global emissions through sector-based strategies and action from global industries to unlock technology and energy transformation.	Challenge site FAQ
MIT Climate Grand Challenges	Grand Challenge/ Moonshot	Mobilize the MIT research community to develop transformative climate change solutions through cross-disciplinary collaboration, with the aim of accelerating development and deployment of innovations that equitably mitigate emissions, remove greenhouse gases, and enable climate adaptation	Challenge site FAQ

NAME	CHALLENGE TYPE	GOAL	RESOURCES
MIT Energy & Climate Hack	Crowdsourcing/ Hackathons	Catalyze innovative artificial intelligence solutions for pressing energy and climate challenges through an annual hackathon bringing together students, experts, and industry leaders focused on accelerating impactful prototypes.	Challenge website FAQ
MIT MSSC Seed Awards program	Grants	Stimulate innovative, high-impact climate and sustainability research and engagement across MIT by funding interdisciplinary teams exploring new directions linked to the consortium's industry and faculty networks.	Challenge site FAQ
NASA Harvest	Grand Challenge/ Moonshot	NASA Harvest is a multidisciplinary Consortium commissioned by NASA and led by the University of Maryland. It enhances decision-making related to food security and agriculture using satellite data domestically and globally	Challenge site FAQ
NASA's harmful algal bloom ML challenge	Crowdsourcing/ Hackathons	Develop accurate machine learning models that identify harmful algal blooms in lakes and reservoirs using satellite imagery to help safeguard ecosystem and public health.	Challenge website FAQ
Open Call for Innovation (O-CFI) - Water and Energy for Food (WE4F) Grand Challenge	Grand Challenge/ Moonshot	Catalyze and scale innovations that enable sustainable intensification of smallholder agriculture through integrated water, energy and food solutions.	Challenge website FAQ
Open Catalyst Challenge	Crowdsourcing/ Hackathons	Advance molecular catalysis design through an open competition challenging teams to accurately predict catalyst relaxed state energy using initial atomic structures.	Challenge website FAQ
OpenClimateFix	Incubator/ Accelerator/ Innovation Hub	Rapidly reduce greenhouse gas emissions by building open-source AI solutions and fostering collaboration between researchers and industry around impactful energy and climate challenges	Challenge website FAQ
Partnership on AI	Incubator/ Accelerator/ Innovation Hub	Convene diverse, international stakeholders to pool collective wisdom and synthesize actionable guidance to ensure AI advances positive outcomes for people and society.	Challenge website FAQ
Powering a Just Energy Transition Green Minerals Challenge	Incentive Prizes/ Competitive Grants	Develop and demonstrate innovative, scalable solutions that strengthen transparency, inclusion, and sustainability in battery and EV mineral supply chains, supporting an equitable clean energy transition	Challenge website Challenge site
RescueNet + AI+HADR Challenges	Incubator/ Accelerator/ Innovation Hub	Advance computer vision and AI techniques for automated disaster damage assessment enabling faster, more effective humanitarian response and recovery efforts	Challenge website FAQ
Responsible Artificial Intelligence for Climate Action in Africa	Grants	Advance climate action across Africa through the responsible development and deployment of AI innovations that address mitigation, adaptation, climate science, and related governance.	Challenge website FAQ
RoadAI	Crowdsourcing/ Hackathons	Develop AI solutions that optimize road construction plans, reducing associated carbon emissions and environmental impact.	Challenge website FAQ
Robust AI Grand Challenge	Grand Challenge/ Moonshot	Develop innovative computer vision techniques that can recover at least 80% of their original accuracy on autonomous vehicle systems after physical adversarial attacks.	Challenge website FAQ
Scale For ClimateTech	Incubator/ Accelerator/ Innovation Hub	Reduce the risk, waste, and cost associated with bringing a hardware product to market	Challenge website Challenge portal
Shell.ai Hackathon for Sustainable and Affordable Energy 2022	Crowdsourcing/ Hackathons	Develop AI solutions that enable access to sustainable, affordable and modern energy for all.	Challenge website FAQ
Shifts Challenge	Crowdsourcing/ Hackathons	Evaluate robustness and uncertainty estimation in machine learning models on real-world data with distribution shifts.	Challenge website FAQ

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Smart Farming Innovations for Small-Scale Producers	Grand Challenge/ Moonshot	Develop scalable digital platforms and farmer services that leverage technology innovations to improve productivity, profitability, and income for small-scale agricultural producers globally.	Challenge website FAQ
SME Climate Hub	Incubator/ Accelerator/ Innovation Hub	Encourage small and medium-sized enterprises (SMEs) to make a climate commitment and take steps towards reducing their environmental impact.	Challenge website Challenge portal
Solar Energy Innovators Program	Grants	Conduct research on innovative solutions for integrating solar energy onto the electricity grid through two-year placements at utilities, energy service providers, or public utility commissions.	Challenge site FAQs
Strengthening African National Regulatory Authorities Data Systems to Enhance and Track Performance	Grand Challenge/ Moonshot	Improve African medicine regulatory systems through coordinated projects developing data platforms that enhance transparency, efficiency, and safety monitoring across sub-Saharan Africa.	Challenge site FAQs
Subak	Incubator/ Accelerator/ Innovation Hub	Find, fund, and scale organizations and individuals who are working towards saving the planet.	Challenge site Challenge website
Sustainability and Digital Reality Manufacturing Challenge	Incubator/ Accelerator/ Innovation Hub	Accelerate the development of technologies that reduce emissions, eliminate waste, and optimize collaborative design in manufacturing through an open innovation program connecting startups with industry experts and partners.	Challenge website Challenge site
Sustainability Open Innovation Challenge 2023	Crowdsourcing/ Hackathons	Catalyze the development and adoption of innovative sustainability solutions addressing climate change, waste, and natural resource depletion by connecting businesses and startups through an open innovation platform.	Challenge website Challenge page
Sustainable Aviation Fuel Grand Challenge	Grand Challenge/ Moonshot	Achieve production of at least 3 billion gallons of sustainable aviation fuel per year by 2030 and meet 100% of aviation fuel demand with sustainable aviation fuel by 2050.	Challenge website FAQs
Sustainable energy solutions with EIT InnoEnergy	Incubator/ Accelerator/ Innovation Hub	Identify scalable or disruptive startups developing sustainable energy solutions that aim for environmental, social, and economic impact.	Challenge website FAQs
Trillion-Pixel GeoAI Challenge	Grand Challenge/ Moonshot	Advance end-to-end geospatial artificial intelligence systems that can process extremely high-resolution multimodal Earth observation data to provide actionable insights supporting science, policy, and national security.	Challenge website Challenge site
Tropical Cyclone Damage Assessment	Incubator/ Accelerator/ Innovation Hub	Advance automated damage assessment capabilities for tropical cyclones using computer vision and geospatial analytics on satellite imagery to support disaster response and recovery efforts.	Challenge website FAQs
UN Climate Change's Initiative on Artificial Intelligence for Climate Action	Grand Challenge/ Moonshot	Accelerate climate action by supporting developing countries to access, develop, and deploy artificial intelligence innovations that reduce emissions and enable adaptation.	Challenge portal FAQs
Venture For ClimateTech	Crowdsourcing/ Hackathons	Accelerate climate technologies and help founders launch startups to commercialize their innovations.	Challenge website Challenge page
Water Supply Forecast Rodeo	Incentive Prizes/ Competitive Grants	Improve seasonal streamflow forecasting through an open innovation challenge engaging data scientists to develop accurate probabilistic models that strengthen water management for the Bureau of Reclamation.	Challenge website FAQs
WCRP Grand Challenges	Grand Challenge/ Moonshot	Address critical climate science barriers through focused, time-bound, transformative international research collaborations yielding actionable information for decision makers.	Challenge website Challenge site

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Wendy Schmidt Ocean Health XPRIZE	Incubator/ Accelerator/ Innovation Hub	XPRIZE is the global leader in solving the world's Grand Challenges by creating and managing large scale incentivized prize competitions that create impact in five areas: Learning; Exploration; Energy & Environment; Global Development; and Life Science...	Challenge website FAQs
XPRIZE Carbon Removal	Grand Challenge/ Moonshot	XPRIZE is the global leader in solving the world's Grand Challenges by creating and managing large scale incentivized prize competitions that create impact in five areas: Learning; Exploration; Energy & Environment; Global Development; and Life Science.	Challenge site FAQs
XPRIZE Rainforest	Grand Challenge/ Moonshot	Rapidly develop technologies that autonomously monitor tropical Rainforest biodiversity in near real-time to better understand and preserve Earth's most diverse ecosystems.	Challenge website FAQs

B. OVERVIEW OF GRAND CHALLENGES IN AI

Below, we list the Grand Challenges and open innovation initiatives in AI that were analyzed as part of this work.

NAME	CHALLENGE TYPE	GOAL	RESOURCES
2023 DataTribe Challenge	Incentive Prizes/ Competitive Grants	Accelerate cybersecurity and data science startups.	Challenge overview Challenge instructions
2023 Edge-Native AI Hackathon	Crowdsourcing/ Hackathons	Drive innovation in edge computing, AI, and hardware-software co-design.	Hackathon site Post-hackathon blog
A2SV Hackathon for Africa	Crowdsourcing/ Hackathons	Empower African youth and catalyze technology innovation addressing local challenges.	A2SV Hackathon for Africa Hackathon Challenge
Accelerate & Innovate: 2023 Year-End Hackathon	Crowdsourcing/ Hackathons	Drive AI innovation and real-world impact.	Post Accelerate & Innovate
Africa Innovation Mradi	Incentive Prizes/ Competitive Grants	Support research exploring the impact of AI on Eastern and Southern African societies.	Africa innovation mradi news Proposals
AI Applied Research Grant Program	Incentive Prizes/ Competitive Grants	Stimulate R&D and demonstrate the potential of AI innovations through industry-academia collaborations.	AI Applied Research AI Applied Research Post
AI Factory Acceleration Program for Startups in Tunisia	Incubator/ Accelerator/ Innovation Hub	Accelerate African AI startups through a 6-month program.	AI Factory Acceleration blog AI Factory site
AI First - Google for Startups Accelerator	Incubator/ Accelerator/ Innovation Hub	Accelerate AI-first startups to tackle technical challenges and scale validated products and services.	AI First - Google Proposals Application Form
AI for Accessibility	Incentive Prizes/ Competitive Grants	Fund and support projects leveraging AI to tackle accessibility barriers faced by people with disabilities.	AI for Accessibility Post AI for Accessibility Blog
AI for Cybersecurity	Incubator/ Accelerator/ Innovation Hub	Develop and deploy trustworthy AI capabilities that strengthen cyber defenses and infrastructure resilience while mitigating risks from AI-enabled threats.	AI for Cybersecurity blog Blog post
AI for Good	Incubator/ Accelerator/ Innovation Hub	Harness artificial intelligence innovations for positive social impact.	Ai for good news AI for Good website
AI For Humanitarians: Shaping Future Innovation	Incentive Prizes/ Competitive Grants	Advance ethical and rights-based integration of AI in humanitarian action.	AI For Humanitarians Innovation AI For Humanitarians Blog
AI for Information Security	Incentive Prizes/ Competitive Grants	Advance AI techniques that strengthen cybersecurity defenses while ensuring AI systems are themselves secure, trustworthy, and aligned with ethical norms.	Proposal Information Hub
AI Grant – accelerator for AI startups	Incubator/ Accelerator/ Innovation Hub	Accelerate AI-native startups building innovative products leveraging AI models..	AI Grant Website AI Project
AI Hackathon	Crowdsourcing/ Hackathons	Catalyze innovative AI solutions addressing real-world problems through a virtual hackathon engaging developers worldwide to rapidly build demos and prototypes leveraging state-of-the-art models.	Challenge page Challenge portal-Hackathon
AI in Medicine & Health	Incentive Prizes/ Competitive Grants	Support innovative AI in healthcare projects with near term positive impact on health outcomes through a seed funding program.	Proposal Article

NAME	CHALLENGE TYPE	GOAL	RESOURCES
AI In Teaching And Learning Grants	Incentive Prizes/ Competitive Grants	Accelerate AI-enabled innovations in teaching and learning through funding for experiments applying artificial intelligence to enhance educational content, assessment, accessibility, equity and other dimensions of learning at scale.	Innovation-hub News
AI Moonshot Challenge	Grand Challenge/ Moonshot	Drive artificial intelligence breakthroughs that harness satellite data for positive environmental and societal impact by connecting international talent through an open innovation challenge.	AI Moonshot Challenge sites Moonshot Challenge
AI Seed Funds	Incubator/ Accelerator/ Innovation Hub	Catalyze integration of artificial intelligence across research and education by providing targeted funding for innovative projects exploring applications and implications of generative models and other emerging capabilities.	AI Seed Funds Proposal AI Seed Funds Proposal
AI startup incubator	Incubator/ Accelerator/ Innovation Hub	Accelerate early-stage AI startups by providing investment, expertise, resources and access to markets needed to rapidly develop, validate and scale innovative solutions and companies.	AI startup incubator website AI startup incubator Proposal
AI Venture Labs	Incubator/ Accelerator/ Innovation Hub	Accelerate cloud-based AI startups to transform industries and positively impact the world through an innovative acceleration model providing equity-free professional services and access to Industry Labs.	AI Venture Labs website Website
AI-BOOST Large AI Grand Challenge	Grand Challenge/ Moonshot	Advance European progress in large-scale AI models by providing funding, supercomputing resources, and visibility to startups and SMEs to develop innovative language models demonstrating state-of-the-art capabilities.	AI Grand Challenge Large AI Grand Challenge
AI2 Incubator	Incubator/ Accelerator/ Innovation Hub	Accelerate the development of AI-powered companies and products with positive societal impact by providing entrepreneurs early-stage support, expertise, and connections through a nonprofit startup incubator affiliated with a leading AI research institute.	Website News
AI4PEP	Incentive Prizes/ Competitive Grants	Support interdisciplinary teams to develop full research proposals that apply AI to address challenges around equitable access to primary and pre-primary education globally.	Website Challenges Proposal
Aicrowd challenges	Crowdsourcing/ Hackathons	Accelerate AI innovation and measure progress by connecting researchers with real-world problems through competitive challenges focused on advancing the state-of-the-art across critical domains like language, robotics, computer vision, and sustainability.	Aicrowd challenges Aicrowd ESCI Challenge
AiNed Fellowship Grants	Incentive Prizes/ Competitive Grants	Accelerate Dutch leadership in artificial intelligence research and innovation through funding for collaborative projects between academia and industry developing impactful AI techniques and applications.	News News
AIPlan4EU project?	Incentive Prizes/ Competitive Grants	Provide easy and unified access to diverse AI planning technologies through a user-centered framework to support practical use cases across sectors like manufacturing, logistics and enable adoption.	Website Post
Alexa Fairness in AI	Incentive Prizes/ Competitive Grants	Fund research projects focused on developing theories, metrics, and methods to detect, mitigate, and evaluate algorithmic bias and ensure fairness in conversational AI systems.	Proposal Post
Allan Turing Initiatives	Incubator/ Accelerator/ Innovation Hub	Advance data science and AI research, development, and adoption in service of economic growth and societal benefit by fostering collaboration through convening diverse expertise, directing strategic investments, and translating innovations into real-world impact.	Theory and Methods Challenge Proposal

NAME	CHALLENGE TYPE	GOAL	RESOURCES
AMS Healthcare Funding	Incentive Prizes/ Competitive Grants	Advance compassionate, ethical, and innovative healthcare in Canada through funding for research, education, technology integration, and historical analysis guiding improvements in clinical practice and policy.	Funding opportunities Post
Antler India Fellowship	Incentive Prizes/ Competitive Grants	Provide funding, resources and mentorship to help India's brightest students validate and launch technology startups through an intensive company building program.	Website News
AppWorks Accelerator	Incubator/ Accelerator/ Innovation Hub	Accelerate early stage startups in Greater Southeast Asia by providing funding, office space, mentorship and access to a regional network of investors, entrepreneurs and industry partners over a 4 month program.	Website Blog
Artificial Intelligence and Data Analytics (AIDA) Grant	Incentive Prizes/ Competitive Grants	Accelerate adoption of AI and data analytics in the financial sector through co-funding industry projects generating business insights and research advancing techniques applicable locally.	Proposal Post
Artists + Machine Intelligence Grants	Incentive Prizes/ Competitive Grants	Advance the emerging field of artists creatively applying machine learning by providing funding and technical support for ambitious interdisciplinary projects exploring artistic uses of AI systems and implications for society.	Intelligence Grants Blog
AWS AI	Incentive Prizes/ Competitive Grants	Promote and accelerate AI startups building innovative solutions on AWS AI/ML services to solve real-world problems and drive business impact.	Proposal Proposal
BIND 4.0 Innovation and Acceleration Program	Incubator/ Accelerator/ Innovation Hub	Facilitate innovation projects between Basque SMEs and startups through an open innovation ecosystem to boost digital transformation and address technological challenges.	Website Industry challenges
BIO x ML HACKATHON	Crowdsourcing/ Hackathons	Accelerate innovation at the intersection of biology and machine learning by engaging talented individuals from diverse backgrounds in an intense competition focused on developing AI-enabled solutions tackling pressing challenges in biotechnology and healthcare.	HACKATHON site Proposal
BonsAPPS	Incentive Prizes/ Competitive Grants	Accelerate SMEs' digital transformation by facilitating AI adoption, enhancing efficiency, fostering innovation, and addressing societal challenges.	Website BonsAPPs Open Call
Building Critical Mass for Data Science Grand Challenge	Grand Challenge/ Moonshot	Promote the buildout of an equitable, accessible data science education infrastructure across California public higher education that engages faculty, enables student pathways, and expands career opportunities.	Grand Challenge Proposal
C3.ai COVID-19 Grand Challenge	Grand Challenge/ Moonshot	Leverage AI techniques to mitigate the COVID-19 pandemic with innovative data analytics solutions for crisis response and scientific discovery.	Grand Challenge News
Catalyst Grant Unleashing the power of AI	Incentive Prizes/ Competitive Grants	Drive innovation in applying artificial intelligence to advance research and create societal impact by providing early-stage funding and support for novel AI-based software tools and technologies.	Proposal Blog
Challenger AI	Incubator/ Accelerator/ Innovation Hub	Accelerate startups leveraging AI/ML to evolve solutions with high growth potential by providing funding, mentorship and access to networks over a 12-week program.	Challenger AI Blog
Cohere For AI Research Grant Program	Incentive Prizes/ Competitive Grants	Advance open fundamental AI research and responsible model development by providing academic partners subsidized access to Cohere's large language models and expert mentors to pursue studies aligned with the lab's priorities around trust, ethics and transparency.	Blog Grant Application
CRAASH	Incubator/ Accelerator/ Innovation Hub	Equip entrepreneurial healthcare teams with knowledge and connections to transform innovative medical technologies into commercially viable startups through a hands-on virtual accelerator program.	Website Post

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Creative Catalyst: AI in the Music Industry	Incentive Prizes/ Competitive Grants	Advance artificial intelligence innovation and integration in the music industry by co-funding up to £1 million for collaborative projects developing new AI products and services that strengthen the UK music sector.	Proposal Post
DARPA Grand Challenge	Incentive Prizes/ Competitive Grants	Catalyze innovations in autonomous vehicle technologies through prize competitions focused on navigating increasingly complex courses and environments without human intervention.	Grand Challenge News
DCASE2024 Challenge	Incentive Prizes/ Competitive Grants	Advance sound and scene analysis research through an annual competition benchmarking state-of-the-art methods on common tasks like detection, classification and tagging of audio signals and events.	DCASE2024 Challenge Post
Democratic inputs to AI	Incentive Prizes/ Competitive Grants	Pioneer inclusive, deliberative processes enabling broad public input guiding AI systems' development and governance as a stepping stone towards fully realizing democratic oversight.	Blog Post
Devpost Hackathons	Crowdsourcing/ Hackathons	Drive AI innovation and develop talent by engaging developers worldwide in intense competitions focused on building functional prototypes and proofs-of-concept leveraging state-of-the-art machine learning tools and models.	AI hackathons Post
DIH4AI	Incentive Prizes/ Competitive Grants	Expand the European network of Digital Innovation Hubs focused on artificial intelligence by attracting additional SME-driven experiments that extend available AI tools and resources while fostering collaboration between hubs, companies and regions.	Website Website
European Lighthouse on Safe and Secure AI	Incentive Prizes/ Competitive Grants	Establish guidelines, standards, and best practices that enable the development and use of AI systems in a way that is safe, secure, ethical and aligned with human values.	Proposal News
Fairness Innovation Challenge	Incentive Prizes/ Competitive Grants	Advance artificial intelligence fairness by funding projects up to £400,000 developing solutions that address issues of bias and discrimination in AI systems.	Proposal News
Fit 4 Start	Incubator/ Accelerator/ Innovation Hub	Accelerate high-potential startups leveraging emerging technologies like AI and healthtech to build innovative and sustainable solutions integrating people, planet and prosperity dimensions.	Proposal Post
Future of Learning: AI Grant (FLAG)	Incentive Prizes/ Competitive Grants	Support faculty experiments with generative AI to improve student learning experiences and pedagogical approaches at Boston University.	Proposal news
GAIA accelerator	Incubator/ Accelerator/ Innovation Hub	Cultivate high-potential generative AI startups through an intensive program offering cutting-edge AI technology, business and technical mentorship to accelerate their development and maximize chances of success.	Website News
GoodAI Grant	Incentive Prizes/ Competitive Grants	Advance research on GoodAI's Badger architecture for artificial general intelligence by funding external projects aligned with key research milestones.	Website Website
Grand Challenges Africa	Incentive Prizes/ Competitive Grants	Catalyze innovative solutions to critical health and development problems in Africa by launching challenge grants that foster collaboration and focus effort toward achieving clear, measurable goals.	Programmes FAQ
Hackathons	Crowdsourcing/ Hackathons	Encourage innovation and develop practical AI solutions that address real-world challenges through collaboration and prototyping.	Website Hackathons - Challenges
HackZone Scale Up Accelerator Program	Incubator/ Accelerator/ Innovation Hub	Accelerate the growth of early stage insurance startups by providing access to APIs, mentors, and global insurance expertise over a 6-month period to advance innovative solutions and business models.	Website Proposal

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Human-centered Artificial Intelligence	Incentive Prizes/ Competitive Grants	Advance responsible and beneficial AI guided by human values through an interdisciplinary research platform spanning computer science, social sciences and humanities that examines AI capabilities and effects on individuals and society.	Sites News
Humanities Research Centers on Artificial Intelligence	Incentive Prizes/ Competitive Grants	Support interdisciplinary examination of artificial intelligence's ethical, legal, and societal impacts by establishing university-based hubs synthesizing humanities scholarship guiding responsible AI progress.	Proposal Post
I-ENERGY	Incentive Prizes/ Competitive Grants	Support European startups and SMEs developing innovative solutions to accelerate the transition to renewable energy systems through an open call offering 50,000€ equity-free funding.	Website Website
IFAB Call for Projects	Incentive Prizes/ Competitive Grants	Advance cross-disciplinary scientific research and real-world applications of big data and AI through collaborative projects between academia, industry, and other partners focused on driving positive societal impact.	Grand Challenges News
IFAC Activity Fund	Incentive Prizes/ Competitive Grants	Support initiatives that foster engagement, inclusion, diversity and public influence of the global control systems community through outreach activities aligned with IFAC's technical areas.	Sites Website
ImageNet Large Scale Visual Recognition Challenge (ILSVRC)	Crowdsourcing/ Hackathons	Benchmark progress in large-scale image recognition and classification by assessing algorithms on a common dataset through an annual competition and workshop.	ImageNet Challenge Blog
INDABA GRAND CHALLENGE: CURING LEISHMANIASIS	Grand Challenge/ Moonshot	Develop an effective, affordable treatment for leishmaniasis by leveraging artificial intelligence to identify potential cures amongst existing drugs through an open innovation challenge engaging researchers, developers, and partners across sectors.	GRAND CHALLENGE Post
Innovation Exchange challenge: Artificial Intelligence and Machine Learning	Incentive Prizes/ Competitive Grants	Explore novel applications of AI/ML for enhancing national security capabilities by engaging startups and academia to propose solutions addressing defined technology gaps and challenges.	Innovation Exchange challenge Machine Learning Challenge
LARGE AI GRAND CHALLENGE	Grand Challenge/ Moonshot	Foster development of large-scale AI models in Europe to provide competitive edge and increase visibility of Europe's activity in this field.	Blog Proposal
Machine Learning on Graph for Interest-based Personalization	Incentive Prizes/ Competitive Grants	Advance graph-based machine learning capabilities for personalized recommendations by developing techniques that model users' diverse interests and complex item relationships from interaction data.	Proposal
Machine Learning, Artificial Intelligence, and Data Resources for Fusion Energy Sciences	Incentive Prizes/ Competitive Grants	Support multi-disciplinary teams to apply advanced algorithms like ML and AI to high-priority research opportunities in fusion energy and plasma sciences through publicly available data resources.	Post Sites
Manchester Prize	Incentive Prizes/ Competitive Grants	Accelerate AI innovation for public good by awarding £1 million annually to UK-based teams developing breakthrough applications of artificial intelligence addressing challenges in energy, environment and infrastructure.	Website Proposal
Microsoft COCO (Common Objects in Context) Challenge	Grand Challenge/ Moonshot	Advance the state-of-the-art in object recognition by placing the question of object recognition in the context of the broader question of scene understanding.	Website Research Paper
Microsoft for Startups Founders Hub	Incubator/ Accelerator/ Innovation Hub	Accelerate innovation and startup growth by providing free access to technology, tools, expert guidance, training, and partnerships needed to build and scale solutions regardless of background or funding status.	Post Website
MIDEM+ Start-up Battles	Incubator/ Accelerator/ Innovation Hub	Accelerate early stage startups leveraging innovations in music, media, gaming, education, and culture by providing visibility, connections, and guidance to further develop their offerings and business models.	Proposal News

NAME	CHALLENGE TYPE	GOAL	RESOURCES
NEATEHUB'S AIC INCUBATION PROGRAM	Incubator/ Accelerator/ Innovation Hub	Nurture entrepreneurs in agriculture and allied sectors by providing incubation support enabling innovative startups to scale sustainably with government backing.	News Proposal
Next AI	Incubator/ Accelerator/ Innovation Hub	Accelerate the growth of early-stage AI startups solving global challenges through an intensive 9 month program providing education, mentorship, facilities and connections with researchers, partners and investors.	Website Proposal
NextGen GPT AI Hackathon with Clarifai	Crowdsourcing/ Hackathons	Drive innovation in generative AI by engaging developers worldwide in an intensive competition focused on building functional prototypes and proofs-of-concept leveraging next generation language models.	Hackathon Overview Blog
Nextgrid AI	Incubator/ Accelerator/ Innovation Hub	Accelerate artificial intelligence innovation with societal impact by investing in startups, connecting them with partners, and providing programs focused on developing AI solutions for industries like energy.	Website Post
NSF Convergence Accelerator Program	Incubator/ Accelerator/ Innovation Hub	Accelerate use-inspired convergence research to transition basic research and discovery into practice, for societal and/or economic benefits.	Program site Program guidelines
NVIDIA Inception	Incubator/ Accelerator/ Innovation Hub	Accelerate technology startups globally by providing free access to NVIDIA platforms, technical resources, investor connections, and other benefits across all stages to help them evolve faster.	FAQ Blog
Physics Grand Challenges 2023	Grand Challenge/ Moonshot	Drive interdisciplinary physics research excellence and real-world impact by funding unconventional projects developed collaboratively with non-physics experts that address major scientific or societal challenges.	Grand Challenges Grand Challenges
Proptech Accelerator Program: Global	Incubator/ Accelerator/ Innovation Hub	Accelerate high-potential early stage proptech startups focused on AI/ML, sustainability, IoT and smart infrastructure by providing funding, intensive mentoring and access to networks over a structured 4-month program.	FAQ Post
Research on Innovative Technologies for Enhanced Learning (RITEL)	Incentive Prizes/ Competitive Grants	Advance teaching and learning through early-stage research on emerging technologies like AI, robotics, and immersive technologies by funding interdisciplinary teams exploring high-potential innovations in authentic educational contexts.	Sites Program Solicitation
Shape the future challenge	Incubator/ Accelerator/ Innovation Hub	Catalyze innovative mobility solutions for sustainability by engaging students and young professionals in an idea contest, mentoring program, and pitch event focused on envisioning and prototyping the future of transportation.	Shape the future challenge Post
Smart India Hackathon 2023	Crowdsourcing/ Hackathons	Foster a culture of innovation, out-of-the-box thinking and problem solving among students by providing a platform to develop solutions addressing real world challenges faced across sectors through an annual nationwide hackathon competition.	Website Proposal
Sound Demixing Challenge 2023	Crowdsourcing/ Hackathons	Drive innovation in audio source separation by engaging researchers worldwide in a competition to develop machine learning systems that most accurately decompose complex musical or cinematic recordings into isolated stems.	Sound Demixing Challenge Blog
SpaceNet	Incentive Prizes/ Competitive Grants	Advance the state-of-the-art in geospatial machine learning by releasing datasets and running annual competitions focused on different aspects of overhead imagery analysis.	Website Proposal
StairAI	Incentive Prizes/ Competitive Grants	Support European SMEs and startups to develop and provide advanced and trustworthy AI solutions through an open call offering 50,000€ equity-free funding, coaching and access to investors.	Website Proposal

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Stanford HAI Seed Research Grants Program	Incentive Prizes/ Competitive Grants	Fund exploratory, interdisciplinary research projects focused on human-centered artificial intelligence that aim to produce initial results advancing HAI's mission of developing beneficial AI systems and applications.	Proposal Proposal
Startup @ARTPARK	Incubator/ Accelerator/ Innovation Hub	Incubate and accelerate deep-tech startups to leverage emerging technologies like AI and robotics to solve challenges in developing countries.	Overview News
Techstars Berlin Accelerator	Incubator/ Accelerator/ Innovation Hub	Accelerate high-potential startups focused on deep tech, climate tech, fintech and future of mobility by providing funding, intensive mentorship, corporate partnerships and access to a global network over a 3-month program culminating in a demo day.	Proposal Blog
TechX Accelerator	Incubator/ Accelerator/ Innovation Hub	Accelerate the transition to affordable net zero energy by supporting innovative cleantech startups through an intensive acceleration program providing funding, mentoring, and access to industry networks.	Proposal Proposal
TED AI For Good Hackathon	Crowdsourcing/ Hackathons	Drive responsible AI innovation for positive impact by bringing together developers worldwide to rapidly prototype solutions addressing pressing societal and environmental challenges.	Post Information Hub
The European AI & Society Fund	Incentive Prizes/ Competitive Grants	Support civil society organizations across Europe to advocate for ethical AI policies that better serve people and society.	News News
The RAAIS Foundation Grants	Incentive Prizes/ Competitive Grants	Advance open source AI research and real-world applications for the common good by providing financial grants to projects anywhere in the world, with a focus on communities lacking access.	Website OPPORTUNITY
Toloka grant program	Incentive Prizes/ Competitive Grants	Advance research in responsible AI by supporting the academic community with credits for collecting labeled data via Toloka's on-demand crowdsourcing platform.	Website Post
Towards human-AI cooperation through natural language	Incentive Prizes/ Competitive Grants	Be realizing seamless, impactful human-AI partnerships across domains by advancing key areas like natural language communication, transparency, and context modeling to enable collaborative intelligence.	Proposal Proposal
Tunga AI Hackathon	Crowdsourcing/ Hackathons	Empower developers with AI tools that enhance their coding capabilities.	Website Post
UC Berkeley AI Hackathon	Crowdsourcing/ Hackathons	Drive responsible AI innovation by engaging over 1000 students worldwide in developing a new generation of AI solutions through an intense weekend of collaboration, learning, and prototyping.	Website Post
UmojaHack Africa	Crowdsourcing/ Hackathons	Empower African youth to solve local challenges through an inter-university machine learning competition that fosters data science skills and pan-African collaboration.	Website UmojaHack Africa challenge
UNICEF Innovation Fund	Incentive Prizes/ Competitive Grants	Fund startups to develop AI/ML solutions improving access and delivery of digital services for children and families in developing countries.	Website Proposal
WAICF AI Startup Challenge	Incentive Prizes/ Competitive Grants	Accelerate AI innovation and adoption by providing startups worldwide a platform to showcase breakthroughs to industry leaders, investors, and the public through competitions awarding festival exhibition space, pitching opportunities, and access to global AI ecosystems.	Website Startup Challenge
Web3 Accelerator Program: Global	Incubator/ Accelerator/ Innovation Hub	Accelerate early-stage Web3 startups to rapidly validate and scale decentralized solutions in areas like DeFi, NFTs and digital identity by providing tailored guidance, networking and funding opportunities.	Proposal Post
Who cares about AI?	Incentive Prizes/ Competitive Grants	Support research on AI's impact on social justice in East and Southern Africa, focusing on technological developments, human rights, and governance.	Proposal FAQ

NAME	CHALLENGE TYPE	GOAL	RESOURCES
Wizeline Generative AI Hackathon 2023	Crowdsourcing/ Hackathons	Accelerate innovation in generative AI by engaging developers to rapidly prototype solutions leveraging generative models that optimize software development or creative workflows.	Hackathon Challenge Post
Worldwide AI Hackathon	Crowdsourcing/ Hackathons	Accelerate AI startups and innovation globally by connecting developers and companies through an accessible competition providing mentoring, networking, funding opportunities and visibility.	Website Post

C. LIST OF STAKEHOLDERS INTERVIEWED

We are very grateful to the following individuals for participating in individual interviews and focus groups and providing input for this report.

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Alex Martin Loewi, *The Dovecote Institute*
Amal Nammouchi, *Karlstad University*
Amir Banifatemi, *XPRIZE*
Andrea Nascetti, *KTH University*
Antoine Marot, *RTE - Réseau de Transport d'Electricité*
Arnon Houry-Yafin, *Zzapp Malaria*
Arun Gupta, *Ted AI*
Ashish Sharma, *Meson Labs*
Budhaditya Chattopadhyay, *Google Arts & Culture*
Chris Wilson, *University of Applied Sciences
Northwestern Switzerland*
Dan Travers, *Open Climate Fix*
David Danks, *UC San Diego*
Deepika Devadas, *Grand Challenges Canada*
Donna Vakalis, *University of Montréal, Mila*
Emily Muller, *Wellcome Trust*
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Ilboudo Dieudonne, *Cascades Water Agency*
Isabel Fletcher, *Wellcome Trust*
Jaison Morgan, *Carrot*
Jay Qi, *DrivenData*
Jed Sundwall, *Radiant Earth*
Jeremy Lo Ying Ping, *DOXA AI*
Johnny Tiu, *The University of the West Indies*
Julia Park, *The Clean Fight*
Karin Strauss, *Microsoft Research*
Karlee Silver, *Grand Challenges Canada*
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Loubna Benabbou, *Université du Québec à Rimouski*
Leyre Madariaga Gangoiti, *Irekia*
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Mark Crowley, *University of Waterloo*
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Natalia Carfi, *Open Data Charter*
Nicolas Farhat, *Water and Energy for Food Grand Challenge*
Nicoline de Haan, *International Livestock Research Institute*
Nigel Greenwood, *Turbine MachineGenes*
Nikolaos Mastrantonas, *ECMWF*
Nomsa Ngoma, *HYBR Group*
Nyla Mabro, *The Clean Fight*
Paola Torres Núñez del Prado, *Stockholm University of
the Arts*
Paolo Fornoni, *T&O Italia*
Paul Hoehn, *German Aerospace Center (DLR)*
Paul Kennedy, *Zindi*
Paul O'Gorman, *MIT*
Raluca Crisan, *Fonciere CEETRUS*
Robert Kirk Patrick, *Dalberg Catalyst*
Ruiz Rivera, *BC Public Service*
Ryan May, *Payable Apps*
Samuel Young, *Energy Systems Catapult*
Sean McGregor, *UL Research Institutes*
Sergio Castellanos, *The University of Texas at Austin*
Sylvain Viguier, *Graphcore*
Tamara Maggioni, *Fundación Ambiente Argentino*
Temidayo Salako, *Tunga*
Tomás Acuña, *AgroSpace*
Tuomas Sorakivi, *gotIT Oy*
Vince Wilczynski, *Yale Center for Engineering Innovation
and Design*
Yuri Shendryk, *Dendra Systems*

D. DETAILS ON REPORT METHODOLOGY

D.1 ANALYSIS PHASES AND DETAILS

Phase 1 - Desk research

1. The research team used different search engines to identify relevant Grand Challenges and other innovation initiatives that relate either to AI for climate and nature or AI more broadly. Note that in compiling the initiatives in AI for climate and nature, we adopted a broad definition of AI to include any algorithmic approach that aids in achieving specific goals, not limited to (e.g.) only the implementation of machine learning or deep learning methods. This approach allowed us to include initiatives that either directly involve AI technologies or indirectly support AI applications and lead to the use of AI in submissions, such as those focused on dataset collection for AI models. Note also that for the purposes of this report, the decision to only focus on these two categories and not include non-AI climate/nature-related challenges was driven by the need to maintain a manageable scope and ensure relevance, as the broader climate and nature space encompasses an extensive range of topics. More specifically:
 - » The team used the queries in Table D.1 (one term from List A + one term from List B) in the search engines to identify these initiatives.
 - » Based on the results received, the project team decided on a set of relevant criteria to include certain challenges and exclude others. These included that the Challenge or initiative fell under one of the main types of initiative analyzed in this study, and either AI for climate and nature or AI more broadly.
2. For each of the relevant initiatives, the project team created an entry in a centralized database and assigned one of two categories: AI Challenge or AI4CN Challenge.
3. For each initiative, the project team filled in information across the following attributes of interest based on information gathered from publicly available materials: organizations involved, the problem statement, the types of submissions, approaches to intellectual property, incentives, and other relevant information. Please consult the appendix to see the attributes of interest.
4. Throughout this process, the project team also gathered and compiled relevant reports, articles, and project briefs relevant to each initiative.

TABLE D.1: List of keywords used in the systemic review for identifying past challenges in AI for climate and nature

LIST A	LIST B
Accelerator Programs	AI Climate Mitigation
Challenge Grants	AI for Climate
Competitive	AI for Nature
Crowdsourcing	Alternative Fuels
Grand Challenges	Autonomous Vehicles
Hackathons	Biodiversity
Incentive Prizes	Biodiversity Conservation
Incubator Programs	Carbon Footprint
Innovation Hubs	Carbon Pricing
Innovation Prizes	Carbon Stock
Innovation Prizes	Clean Energy Access
Moonshot Initiatives	Climate Action
Open Innovation Initiatives	Climate Adaptation
PublicPrivate Challenges	Climate Change
Research grant	Climate Change Mitigation
Tech Accelerators	Climate Prediction
Technology Prizes	Climate Resilience
	CO2 Removal
	Digital Solutions Climate
	Disaster Response
	Ecosystem Conservation
	Ecosystem Monitoring
	Electric Vehicles
	Electricity Systems
	Energy Demand
	Energy System
	Environmental Sustainability
	Forecasting Supply and Demand
	Freight Optimization
	Fossil Fuel Emissions
	Fusion Science
	Greenhouse Gas Emissions
	Low-carbon Options
	Low-Data Climate Solutions
	Low-Emissions
	Machine Learning Climate
	Materials Science
	Monitoring
	Monitoring Peatlands
	Policy Evaluation
	Precision Agriculture
	Renewable Energy
	Remote Sensing
	Smart Agriculture
	Smart Buildings
	Smart Cities
	Solar Geoengineering
	Sustainability
	Transportation
	Waste
	Wildlife Conservation

Phase 2 - Survey and stakeholder identification

1. The questions in the survey asked about:
 - » The names and background of past or ongoing Grand Challenges
 - » The stakeholder's involvement in those Grand Challenges
Interest in speaking with the project team further about this Challenge
 - » Any initial insights or observations about the Challenges
2. The team distributed this survey via social media platforms, including Twitter/X, LinkedIn, and CCAI's Community Platform
3. These responses were carefully analyzed and any individual who had both participated in a Challenge and expressed interest in further contact was flagged as a stakeholder of interest
4. Simultaneously, Center for Open Data Enterprise (CODE) and Data Innovators (DI) carried out additional desk research to identify the names of stakeholders directly involved with the challenges identified in Phase 1. The team analyzed the websites and other relevant online materials for the Challenges to identify potential stakeholders for interviews and focus group discussions.
5. The team identified six categories of stakeholders: judges, participants, organizers/partners, sponsors/funders, mentors, and program evaluators.
6. DI focused on stakeholders who were part of challenges that mainly focused on AI applications while CODE focused its stakeholder list on challenges that focused both on AI for climate and nature.

Phase 3 - Interviews and focus groups:

1. For outreach, the project team partitioned the list between DI and CODE based on geography and the focus of the challenge. CODE focused primarily on stakeholders in the Global North while DI prioritized stakeholders based out of Global South. The project teams were distributed at various time zones, scheduling interviews around the clock.
2. The overall outreach plan for interviews included four waves of email communications, resulting in a total of 55 individual interviews:
 - » **Initial Outreach to Stakeholders:** The project team extended approximately 270 invitations for interviews and secured 30 initial interviews.
 - » **Additional Identification of Stakeholders:** After a lower response rate, the project team identified 10 additional stakeholders to conduct additional individual interviews.
 - » **Stakeholder Referrals:** Interviews were concluded by asking for any additional stakeholder referrals who should be interviewed for the

project. Through this method, the project team contacted an additional 15 individuals.

- » **Final Wave of High Priority Contacts:** The final wave of outreach included outreach to a number of individuals involved in high priority Challenges organized by entities such as the Bill & Melinda Gates Foundation, XPRIZE, and Microsoft. These Challenges were prioritized on the basis of their global outreach, scale of impact, and online presence.
3. Participants would book times for a 45 minute individual interview. The team would then share a list of general questions along with tailored questions prior to the interview.
 4. Each interview included a lead interviewer and a notetaker, who would use a template to track responses to each question and also gather recordings. All of these interview results were uploaded into a shared online file-sharing repository and included transcripts.
 5. In addition, the CODE and DI teams identified several groups of stakeholders who were interviewed in a focus group setting. The 3 focus group discussions were designed to gather focused information for the specific challenges especially pertaining to a certain stakeholder group. The focus group discussions included two formats:
 - » Focus group with multiple stakeholders from a single challenge: The project team would include members who participated in different dimensions of the same challenge to gain insights into their experiences with the same Challenge.
 - » Cross-challenge stakeholder focus group: These groups were formed from survey respondents and helped the project team understand the dynamics of different stakeholders in different Challenges and compare experiences across groups.

Phase 4 - Analysis and gap identification:

1. All findings were uploaded and kept up to date at a secure, centralized repository for collective analysis and cross-referencing. This includes literature review matrices, a merged list of identified stakeholders, interview notes, and interview transcripts and/or recordings where interviewees have consented.
2. Brainstorming sessions were held within the team to share insights, findings, and prioritization to define the key insights, obtain a comprehensive view of the landscape of GCs in AI for climate and nature, and prioritize 3-5 central questions to explore further. Mural,¹³⁹ a visual collaboration tool, was used to minimize affinity bias.
3. Following the findings from these sessions, we consolidated all ideas into an immediate list of needed report components, including a stakeholder analysis matrix, a taxonomy of challenges, an impact assessment framework, and a literature review to identify additional previously

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overlooked directional goals of interest to Grand Challenge designers. This also helped to tailor the structure of future interviews and fine-tune questions for subsequent interviews to fill in any information gaps.

4. The team worked to review the interview notes to identify themes and areas of interest/focus, to identify specific insights and/or case studies that would be of interest to the analysis. These facilitated further understanding of the barriers faced and the impact achieved through the various challenges/initiatives. An analysis matrix was developed from the synthesis of the interview notes, which served as a structured way to map and cross-reference insights across interviews and desk research. These mappings revealed clear patterns linked to the questions identified above.

Phase 5 - Report synthesis:

1. An iterative process was used to outline the recommendations and the structure for the final report. Based on the findings from desk research and stakeholder interviews, a checklist for operationalizing a grand challenge was developed. The recommendations are thus formulated to respond directly and exclusively to these sets of questions, ensuring both alignment with the pre-established checklist and integration of new insights as they emerge.
2. From the above collected information, insights and findings, a set of recommendations has been outlined by CCAI as a core guideline for responding to the previously identified questions. For each question, there is a single section that starts with the identification of a gap, and then includes a set of recommendations merging the what to do (gaining insights from success stories) and what not to do (following identified pitfalls, failure modes, or interview insights), augmented by examples from past and current Grand Challenges and other open innovation initiatives to provide additional context and references.
3. From the set of recommendations, CODE and DI brought in their previously acquired knowledge and expertise to describe relevant examples and case studies, discuss how questions were addressed, and to further detail some of the recommended frameworks or practices.
4. An iterative, agile process was used to shape these recommendations, reviewing, fleshing out, and contextualizing them in parallel, while continually refining the question sets to guide the recommendations section.
5. The recommendations were grounded primarily on the findings through desk research and stakeholder interviews, as well as the team's professional expertise. Each member of the team worked on either conceptualizing, writing, editing, or reviewing the final report.

D.2 INTERVIEW QUESTIONS

General Questions

- » Let's begin with a quick round of introductions and getting to know you. Can you tell me more about your organization and your role there?
- » Tell us more about the Grand Challenge/Innovation Initiative that you participated in. What drew you to participate? What was its primary value proposition?
- » Can you comment on the design and the structure of the Grand Challenge/Initiative? How does this design help it achieve your objectives? Why or why not?
- » What were the direct results or outcomes of this Challenge? Let's first talk about direct results, i.e., products or immediate benefits to the ecosystem.
- » How have the outcomes been impactful for yourself as an individual? And how have they impacted the broader ecosystem of research/deployment/innovation?
- » How were the winning products and tools disseminated to a wider audience?
- » From your perspective, what were some of the parts of the Challenge you would have improved? Why?

Stakeholder-Specific Questions

ORGANIZER/PARTNER. Based on your responses and our research, we understand that you were an organizer/partner in this challenge. We wanted to ask several questions related to that role in the Challenge.

- » Tell us more about the steps you took to develop the Grand Challenge and its value proposition.
- » Who was the target audience for the Grand Challenge, and what was the anticipated volume of participation? Please also comment on the scale of the challenge in terms of participation and outreach.
- » How have you incorporated feedback and iterated on the design of future challenges?
 - » [Possible sub-question - skip if time doesn't allow]: What prospective assessments are conducted to identify gaps and opportunities for new grand challenge initiatives?
- » What efforts did you make to diversify the kinds of participants, judges, or sponsors who joined the Grand Challenge?
- » Can you describe the breakdown of the judging panel and any evaluation criteria you developed to select them?
- » Can you please also comment on the criteria for success for the applications?
- » In your experience, were there any unique approaches to maintaining the intellectual property for the material and the ideas generated as part of this challenge such as transfers to the sponsor, open source, goes into the public domain, etc.?
- » Can you also provide more information on the incentives and benefits

provided to the winners of the challenge whether monetary or otherwise? For example, non-monetary incentives might include access to data, demonstration opportunities, exposure to funders, regulatory relief/fast track, etc.

- » What was one thing that worked well in organizing the Grand Challenge that you'd recommend? What was something that could be improved?
- » From this challenge, what impact do you expect/have you seen on the broader ecosystem of research/deployment/innovation?

JUDGES. Based on your responses and our research, we understand that you were a judge in this challenge. We wanted to ask several questions related to that role in the Challenge.

- » Tell us more about when you entered the Challenge as a judge and what your onboarding experience was like.
 - » [Related question:] How did you familiarize yourself with the challenge themes, goals, and evaluation criteria before you stepped in to judge the Challenge?
- » Do you have a sense of how the criteria were set? Did you make any amendments or recommendations to the judging process?
- » Was there any post-challenge engagement with you or other judges to gather insights on what worked well and what didn't?
- » Can you describe the decision-making process for selecting winners or recognizing outstanding contributions?
- » What was one thing that worked well as a judge that you'd recommend? What was something that could be improved?
- » How have the outcomes of the challenge been impactful for yourself as an individual? And how have they impacted the broader ecosystem of research/deployment/innovation?

PROGRAM EVALUATORS. Based on your responses and our research, we understand that you were an evaluator in this challenge. We wanted to ask several questions related to that role in the Challenge.

- » What role do program evaluators play in ensuring that challenges and innovation funds integrate both scientific rigor and practical, actionable outcomes?
- » How can AI-driven challenges be structured to prioritize both rapid innovation and long-term sustainability?
- » What type of mechanism can be deployed to make sure the funded projects are evaluated for both immediate needs and long-term impact and scalability?
- » What strategies can be employed to ensure that the environmental impact assessments of AI projects are comprehensive and robust?
- » How are project proposals evaluated for their value proposition and potential to catalyze systemic changes (in climate and nature)?
- » What are some of the key lessons learned from evaluating past initiatives that will inform the strategy and criteria development for upcoming Grand Challenges?
- » How have the outcomes of the challenge been impactful for yourself as an individual? And how have they impacted the broader ecosystem of research/deployment/innovation?

SPONSORS (KEY FUNDERS SUPPORTING THE GRAND CHALLENGE OR INITIATIVE, SEE SECTION 6). Based on your responses and our research, we understand that you were a sponsor in this challenge. We wanted to ask several questions related to that role in the Challenge.

- » To begin with, what motivated you to sponsor this Challenge? Why did you choose to focus on AI?
- » What made you want to use a Grand Challenge model rather than something different?
- » What were your primary objectives in setting up the Challenge and what kinds of audiences did you want at the table?
- » How does your organization assess the long-term impact of the grand challenges it sponsors?
- » Are there specific indicators or measurements used to evaluate the success of the Challenge? Of the products produced?
- » How would you advise other organizations seeking to set-up Grand Challenges?

PARTICIPANTS. Based on your responses and our research, we understand that you were a participant in this challenge. We wanted to ask several questions related to that role in the Challenge.

- » What motivated you to join the Challenge as a team? How did you hear about it?
- » Can you tell us about the product your team produced and how the Challenge helped you create it? How did you manage this intellectual property and report it?
- » What incentives attracted you to participate (monetary, non-monetary, exposure to experts, etc.)? Do you think these incentives helped boost participation?
- » Were there any specific recognitions or awards that participants could earn?
- » What do you think was the most helpful part of the Challenge as a participant? What about an area that could be improved?
- » What has your work on this project looked like since the completion of the Challenge? Did the Challenge inspire any other work for you?
- » In your opinion, how have the outcomes been impactful for the broader ecosystem of research/deployment/innovation?

Wrap-Up Questions

- » Thanks again for participating in this interview - your responses have been very helpful. Before we move into the wrap-up, would you like to share any other opinions on your particular Challenge or Grand Challenges that you haven't had the chance to share?
- » Before we conclude the interview, please let me know if you have any questions for me.
- » Lastly, we're hoping to cast a very wide net to understand the full ecosystem of Grand Challenges and open innovation initiatives. Can you share any recommended contacts or individuals who could help us in this process?
- » Any closing thoughts?
- » We thank you for your time and will be in touch if we have any follow-ups.

D.3 SURVEY

Thank you for your interest in contributing to our assessment of Grand Challenges and open innovation initiatives in AI for climate and nature and AI more broadly.

With support from the Bezos Earth Fund, we are in the process of mapping the landscape of past and current efforts, and your input and insights are invaluable in shaping future initiatives that can make a significant impact.

The survey is brief and will only require 5 minutes of your time.

Past Grand Challenges

1. Are you aware of any past or ongoing Grand Challenges or open innovation initiatives related to AI for climate and nature?

A Grand Challenge or innovation initiative is an event (e.g., competition, project, initiative) that seeks to engage participants over a period of time and produce impactful solutions.

2. If yes, please share the name and background of that Grand Challenge or innovation initiative for climate and nature.
3. Are you aware of any past or ongoing Grand Challenges or open innovation initiatives related to AI more broadly (not necessarily climate-focused)?
4. If yes, please share the name and background of that Grand Challenge or innovation initiative for AI.
5. Have you been involved in any of the Grand Challenges or open innovation initiatives you mentioned above? (e.g., organizer, participant, funder, judge, observer)
6. If yes, please describe your role in the Grand Challenge(s) (e.g., organizer, participant, funder, judge, observer)
7. Would you be willing to provide more details and/or talk more about AI challenges, including their design, outcomes, and impact?
8. Are there any major thoughts, insights, or reflections you would like to share on these topics now?

We value your insights and respect your decision to not engage further in this process. If you are able to recommend individuals and/or organizations within your network who could provide further details on the Grand Challenges and initiatives listed earlier, we would greatly appreciate your assistance.

9. Names of Individuals and/or Organizations

10. We highly value your expertise and insights. If you are willing to engage in a follow-up discussion, please provide your contact details below.

Full Name *

Email *

Institutional affiliation

Please recommend any individuals or organizations that we should consult.

11. Any additional information or insights you would like to share?

D.4 FOCUS GROUP DISCUSSION QUESTIONS

Introductions

- » Can you tell me more about your organization, role, and the prize challenge you were involved with?

Value Proposition and Incentives

- » To begin with, let's talk about the vision of the Grand Challenge and how you established the value proposition.
- » From your perspective, what makes a Grand Challenge impactful? How did you evaluate the Grand Challenge against the value proposition?

Note to Facilitator: If it hasn't come up already, please ask about the incentives to different kinds of Challenge groups such as incentives for judges, coaches, evaluators, participants, etc.

Focus and Problem Statement

- » How did you choose focus areas or targets based on this value proposition? How did you write the problem statement?
- » Would you still target those focus areas today? If not, what would you choose?

Audience and Outcomes

- » Let's move to the audience and some of the outcomes. How did you make sure you were reaching the intended targeted audience for participation?
- » Did you employ any strategies to reach specific audiences, e.g. DEI metrics or considerations?
- » How did the challenges you supported support the overall ecosystem of innovation and/or climate?

Impact and Sustainability

- » In your experience, how is the sustainability of the initiatives considered after they're completed? How are the initiatives scaled up for future initiatives?

Challenges and Limitations

- » What are some of the overall challenges and limitations that you saw emerge during the lifecycle of your grand challenge?
- » In your experience, what are the gaps, opportunities, and recommendations that can be helpful for future challenges?

Wrap-Up/Final Comments

- » Thanks again for participating in this focus group - your responses have been very helpful. Before we move into the wrap-up, would you like to share any other opinions that you haven't had the chance to share about your experience in/with a challenge?
- » Before we conclude the interview, please let me know if you have any questions for me.
- » Lastly, we're hoping to cast a very wide net to understand the full ecosystem of Grand Challenges and Innovation Initiatives. Can you share any recommended contacts or individuals who could help us in this process?
- » Any closing thoughts?
- » We thank you for your time and will be in touch if we have any follow-ups.

D.5 TYPES OF SOLUTIONS

Grand Challenges and open-innovation initiatives in AI for climate and nature solicit various types of solutions. In what follows, we provide a brief explanation of each of these solution types:

- » **SOFTWARE:** Computer programs, applications, or code that perform specific tasks or functions. The software itself is the end deliverable. This can include applications, mobile applications, desktop software, or platforms.
- » **PROTOTYPES:** Early models or preliminary versions of a product built to test a concept or process and demonstrate its feasibility and functionality. Prototypes demonstrate how a particular solution might work in practice and are often used to test and refine concepts prior to full-scale production.
- » **AI MODELS:** Machine learning or deep learning models that have been trained to perform specific tasks such as prediction, classification, or optimization.
- » **PROPOSALS:** Detailed proposals or plans for how a project or solution will be carried out. They typically include objectives, methods, expected outcomes and resource requirements. The proposal itself may be the final deliverable, particularly for early-stage or ideation-focused challenges.
- » **BEST PRACTICES:** Methods or techniques that have been shown to be effective in achieving specific results. These are often shared to guide others in implementing similar solutions, and may document strategies or processes that have been identified as most effective in addressing specific issues.
- » **RESEARCH PROJECT:** Structured investigations or studies conducted to explore specific hypotheses or research questions and contribute to new knowledge, methodologies, or technologies. The research process and results are the primary outputs. May include experimental studies, data collection, and analysis.
- » **DATASETS:** Collections of data that can be used for analysis or to train and/or test AI models. Curation and sharing of high quality datasets is typically the end goal.
- » **POLICIES:** Formal recommendations or frameworks designed to guide decision making and governance. Often intended to influence regulatory or organizational practices.
- » **HARDWARE:** Physical systems or equipment used in a system. May include sensors, processors, devices, and other components.
- » **RESEARCH PAPERS:** Scholarly articles and reports that present original research, methodology, and analysis. Papers that are peer-reviewed and published in academic journals are typically the primary objective.