Dynamic Philanthropy

A Framework for Supporting Transformative Climate Governance in the Digital Age

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Forward

Humanity has reached a turning point. Activists, scientists, governments, and citizens are all calling for urgent and transformative action now to navigate two of our greatest challenges: climate change and inequality arising from digital transformation. In this final stretch to limit temperature increase to 1.5°C, we must work together to re-imagine the collaborations, processes, and structures that govern our economy, environment, and society. This re-imagining must be focused on agility and resilience, so that we can leverage digital tools in a safe and inclusive way to accelerate climate action and meet our global goals. As catalysts, conveners, and community builders, philanthropy can help in this re-imagination by creating change through targeted investments that bridge diverse actors and by supporting key processes that help develop innovative, inclusive, and transformative climate solutions in the digital age.

This report is a synthesis of insights from researchers, philanthropists, venture capitalists, social entrepreneurs, and technology innovators across five continents who work at the intersection of digital technology and climate action. The findings helped identify transformative entry points for philanthropy and other key players to help nourish this re-imagination. Many of these actions, some previously understated, encompass shifts in mindsets and culture, including within the philanthropic community itself. For example, destigmatizing failure to allow for risk taking, handing over control to encourage local leadership, and shifting to maximizing long-term value over short-term impact. We hope the report will also inspire philanthropy to continue collaborating with actors that connect them with diverse stakeholders across scales and disciplines who can support in the implementation and contextualization of these priority actions.

Furthermore, the report also brings forward a database of initiatives that are already addressing the complexity of climate change by leveraging digital tools. These examples are analyzed to determine how they are also encouraging culture shifts and more agile ways of working.

We are grateful for all the input and expertise received from actors across diverse geographies that helped visualize the transformations we present. With these interventions we can hope to guide and support philanthropy and other actors across the world in their work to implement sustainable, inclusive, and just solutions to climate change in the digital world.

– Casey Cronin
Director, Global Intelligence
ClimateWorks Foundation

Executive Summary

"Many argue that the scale, pace, and complexity of human-induced changes in the Earth system, and the severity of the risks they pose to humanity, require new approaches to environmental governance. The digital age has created new opportunities for transforming environmental governance, but the power of these new tools cannot be fully leveraged if they are simply adopted by existing institutional structures. Using new tools to govern in old ways will not solve the problem. We need to reimagine global environmental governance in the digital age."

– Amy Luers, PhD, Global Lead for Sustainability Science, Microsoft

Digital technologies can accelerate climate action and make way for more reflexive, decentralized, and inclusive governance systems that address the complexity of climate change and help meet climate goals. However, the digital age is not a silver bullet; it can amplify inequalities and increase our carbon footprint. To avoid these risks, we must break silos and convene the climate governance, technology and innovation, and finance sectors to form more inclusive partnerships that can leverage digital technologies in a sustainable manner.

To explore how philanthropy can help facilitate these partnerships, Sustainability in the Digital Age and Future Earth, in collaboration with ClimateWorks Foundation, initiated the Re-Imagining Climate Governance in the Digital Age project. The project convened actors working at the intersection of digital technology and climate change across different geographies to explore the gaps, for example in social capital, literacy, trust, digital inclusion, leadership and power, that should be addressed to facilitate cross-sector cooperation. To this end, the **Strategic Framework for Philanthropic Interventions in the Digital Age: Entry Points for Supporting Transformative Climate Governance** was developed. The framework is composed of three main processes, **Co-learning and trust building, Testing and co-development,** and **Integration and scale**, centered around an integral element: **Fail forward and share** (see Box 1 below for the summarized framework and Chapter 2 for the full version). The strategic framework and other key project findings are guiding tools for philanthropy and others to kick start transformative digitally enabled climate action.

To further characterize the intersection of digital technology and climate action, the project team also developed a **Digital Climate Projects Database** of 210 examples of digitally enabled climate initiatives. Remote sensing technologies (satellites, drones, and sensors), alongside mobile applications and online data platforms were identified as the most commonly used technologies, followed by artificial intelligence (AI), machine learning, and blockchain.

Analysis of the database identified four strategy types employed by these initiatives that contribute to climate governance. **Data mobilization and Digital optimization of existing strategies** act as building blocks to ensure the availability of clear, accurate, and actionable data to enable the **Incentivizing and automating of behavioral change and Participation and empowerment of local actors** that help change the norms, rules, and power within the climate governance system. Further analysis also highlighted a dominance of private sector actors in leading and funding digitally enabled climate action and the need for more locally led initiatives, particularly in South America and Africa.

Box 1. The Strategic Framework Summarized: 8 Actionable Takeaways for Philanthropy to Support Transformative Climate Governance

Fail forward and share

1 Encourage the sharing of failures and lessons learned to shift towards a more agile, collaborative, and learning community of practice.

Co-learning and trust building

2 Engage with intermediaries that can connect diverse actors across disciplines and geographies, including local actors, with technology experts to increase inclusivity in this sector and increase appropriateness of technologies being developed.

3 Organize regular convening spaces where actors can build trusted relationships and partnerships and increase collective awareness on transformative climate governance and digital technologies.

Testing and co-development

4 Offer grants with succinct reporting requirements and longer and flexible timelines to allow for more iterative testing of solutions.

5 Invest in blended finance mechanisms that reduce risks and costs in enabling and scaling of digital technologies for climate action in order to attract new investors.

6 Apply more inclusive and ethically-sound criteria to evaluate impact aligned with a just transition.

Integration and scale

7 Support the development of more local leaders to help champion, integrate, and adapt inclusive digital solutions to climate change in different social and economic systems across geographies.

8 Implement digitally enabled pilot climate projects that are sustainable, transformative, and inclusive, to test and improve frameworks that can then be adapted and amplified across sectors and scales.

1. Re-imagining Climate Governance in the Digital Age

"A huge percentage of the global population don't have access to stable high-speed internet, to computers, or to smartphone technology. This is what we refer to as the digital divide. When pursuing digital solutions to climate change, we have to make sure that we do not perpetuate this divide and create solutions inaccessible and not beneficial to large parts of the world."

– Angel Hsu, PhD, Assistant Professor UNC Chapel Hill; Director, Data-Driven EnviroPolicy Lab

Leveraging digital tools to transition to 21st century climate governance

As we move further into what the United Nations has termed the Decade of Action, there is mounting pressure on governments, international organizations, funding communities, the private sector, and more, to accelerate climate action [1-4]. And despite substantial efforts by states towards Nationally Determined Contributions and net zero pledges by countries, projections still forecast a 2.1°C temperature increase by 2100 [5].

We therefore need to urgently unleash societal transformations, support extensive collaborations, facilitate technology innovation and transfers, and amplify findable, accessible, interoperable, and reusable (FAIR) climate data

to help meet our climate goals [2,6,7]. But the climate governance system in place must have the capacity to govern these transformations [8,9].

Environmental governance is defined as "the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change" [10]. To enable a governance system capable of effectively addressing climate change, its structures and processes must be strengthened to include more decentralized but interlinked governance units [11] that operate horizontally and vertically across all levels[1] [12,13] with increased agility, adaptability, support for bottom-up approaches, and built-in systems of accountability [14]. This vision of 21st century governance is also more open to risks and failures [14,15].

While these changes seem daunting, the powerful tools of the digital age present opportunities to push environmental governance systems into the 21st century and achieve goals such as the Paris Agreement on climate change and the United Nations Sustainable Development Goals [2,16-19]. For example, distributed ledger technologies (often referred to as blockchain) can track greenhouse gas emissions across value chains which can, in the right contexts, increase the accountability of actors operating along those value chains [20,21]. Blockchain also allows for more decentralized governance systems by increasing access to transparent, auditable data, and capital flows [22]. Mobile technologies, digital platforms, and the Internet of Things are connecting individuals across the globe and have the potential to increase opportunities for direct engagement in decision-making [23].

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1   Macro, meso, and micro: Macro level governance refers to the international or national level frameworks; micro level focuses on the regional or local structures, namely the norms and rules of individuals and small groups that operate at the scale of research and innovation; and the meso level encompasses the actors, networks, activities, and establishments that help connect the macro and micro levels [13].

Risks must be addressed

Despite the evident potential of leveraging digital innovations to transform governance, there are clear risks which must be addressed. Foremost, concerted efforts must be made to bridge the digital divide by increasing equitable access to and benefits from digital technologies. Without such measures, leveraging the digital age can perpetuate existing biases and inequities and prioritize actors already in positions of power [6]. As digital technologies become increasingly pervasive, concerns about digital colonialism[2] [24], privacy, and cybersecurity continue to grow, calling attention to the need for oversight and transparency in how data is collected, owned, stored, used, and ultimately disposed of [6,25]. If mismanaged and not powered through low carbon energy sources, the carbon footprint of the ICT sector could grow from 2% (current estimates) to 14% of all greenhouse gas emissions by 2040 [26]. Furthermore, while applications of digital technologies such as digital nudging and microtargeting have the potential to incentivize more sustainable choices, so far they have led to higher levels of consumption and resource demand [27,28].

Role of philanthropy

To help reduce these risks and accelerate the effective use of digital disruptions for a sustainable, inclusive, and just path, all actors – including researchers across disciplines, funding communities, regulators, civil society, and innovators – must work together (Figure 1). However, there is currently a disconnect between these actors (see Chapter 2) which is inhibiting the speed of progress and limiting the transformative potential of experimentation and collective deliberation. The high failure rate (85%) of AI [29], lack of contextualization [30], lack of investments in building social capital and trust, and literacy gaps [31] all create and add to the tensions at the the intersection of digital technology and climate governance. By taking an active role in bridging and building trust between actors, philanthropy can help eliminate these tensions and catalyze the collaborations and innovations necessary to scale transformative digital solutions for climate change [32].

Capital is also crucial. In 2020, philanthropy (including foundations and individuals) invested between $6 billion to $10 billion on climate change mitigation, a 14% increase from 2019. Despite this improvement, climate mitigation still accounts for less than 2% of all philanthropic spending [33,34]. In total, it is estimated that an annual budget of $5 trillion is required to help us meet our climate goals [2]. While the world will heavily depend on public and private sources for these funds, philanthropy can play a key role in unlocking the needed investments [34] by addressing the misalignment between actors (as noted above) which is often a barrier to investment [35].

Aside from increased funding in this space, the initiatives and strategies being supported must have the ability to transform climate governance and scale sustainable solutions globally – "the more we invest with foresight, the less we regret with hindsight" (Amina Mohammed, United Nations' Deputy Secretary-General, 2021) [35]. To pinpoint the most valuable actions for philanthropy at the intersection of digital technology and climate governance, Sustainability in the Digital Age and Future Earth, in partnership with ClimateWorks Foundation, launched the **Re-Imagining Climate Governance in the Digital Age project**. The project included a series of consultations with experts from climate science, governance, digital innovation, and funding communities (a total of 54 participants from 14 countries across 5 continents), and a landscape study of existing digitally enabled climate initiatives. The project also received strategic guidance from an International Advisory Group.

Based on these insights, **this report presents a strategic framework for philanthropic interventions in support of digitally enabled climate initiatives that can help strengthen and transform climate governance in the 21st century. The report also analyzes the Digital Climate Projects database, a collection of 210 concrete examples of the different applications of digital technology for climate action.**

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2   Pursuing political, economic, and social dominance in a different nation or territory through the means of digital tools [24].

ROLE OF PHILANTHROPY

Figure 1. Researchers and technology innovators, investors, regulators, and civil society must work together to build on shared values and transform the current climate governance system to move towards an equitable and climate safe world in the digital age. Philanthropy can play a key role in facilitating this process by bringing together these actors and creating new opportunities for collaboration and investment towards transformative change (adapted from the Digital Disruptions for Sustainability Agenda (D^2S Agenda), SDA, 2020).

2. A Strategic Framework for Philanthropic Interventions in the Digital Age

"We need to create a system that redefines failure as a lesson and part of progress. Failures of today drive innovative solutions of tomorrow. Actors should be encouraged and incentivized to share not only successes but also their failures openly instead of hiding them. This will require philanthropy to change mindsets around failure and build new forms of incentives."

– Hakizumwami Birali Runesha, PhD, Associate VP & Founding Director, Research Computing Center, University of Chicago

Fail forward and share

The **Strategic Framework for Philanthropic Interventions in the Digital Age: Entry Points for Supporting Transformative Climate Governance** (Figure 2), presents priority steps that must be taken when developing effective digitally enabled climate initiatives.

The framework is composed of three phases, starting at the top and moving clockwise, and is centered around a key element: Fail forward and share. Depicted in a cycle, this framework conveys the interdependence and interconnectedness of the different phases in developing transformative solutions for climate action in the digital age, which collectively can help support a transition towards a more sustainable and equitable climate governance system. Action items summarizing the framework are also presented in *Box 1. The Strategic Framework Summarized: 8 Actionable Takeaways for Philanthropy to Support Transformative Climate Governance* (page 6).

The framework is based primarily on inputs collected from the expert discussions held throughout the project on the opportunities and challenges of leveraging digital technologies for climate action. It is also supported by insights from academic literature and other sources, selected examples of which are drawn into the descriptions below. The landscape of knowledge at the intersection of digital technology and climate governance remains fragmented. By incorporating insights from multiple perspectives, our aim is to begin building bridges amongst inherently interconnected concepts that are currently operating in isolation from one another.

As depicted at the center of Figure 2, **Failure is a crucial component across the entire development cycle for digitally enabled climate strategies**. By taking the opportunity to carefully reflect on reasons for failures and learn from them, organizations or initiatives can shift from a static state to an iterative and learning state, incorporating lessons from past experiences more seamlessly into future planning and operating at a higher level of efficiency and effectiveness – failing forward [36-37]. This is critical to address complex problems [38] and foster more visionary and agile strategic planning, key components for decision making in contexts characterized by volatility, uncertainty, complexity, and ambiguity [39]. However, failure is frequently viewed negatively, particularly in funding communities, where reporting metrics often focus primarily or exclusively on positive results [37,40]. This has led to a culture of stigma around failure, where unsuccessful stories are not reported openly and important lessons and learning opportunities among peers are routinely missed out on [37]. Destigmatizing failure for example by encouraging failure reporting for funding grants will help remove fear in sharing failures amongst grantees and has the potential to catalyze a necessary culture shift within and beyond funding communities in how we approach failure [37]. The concepts of fail fests and fail forward consulting are already underway as attempts to start shifting this culture of failure.
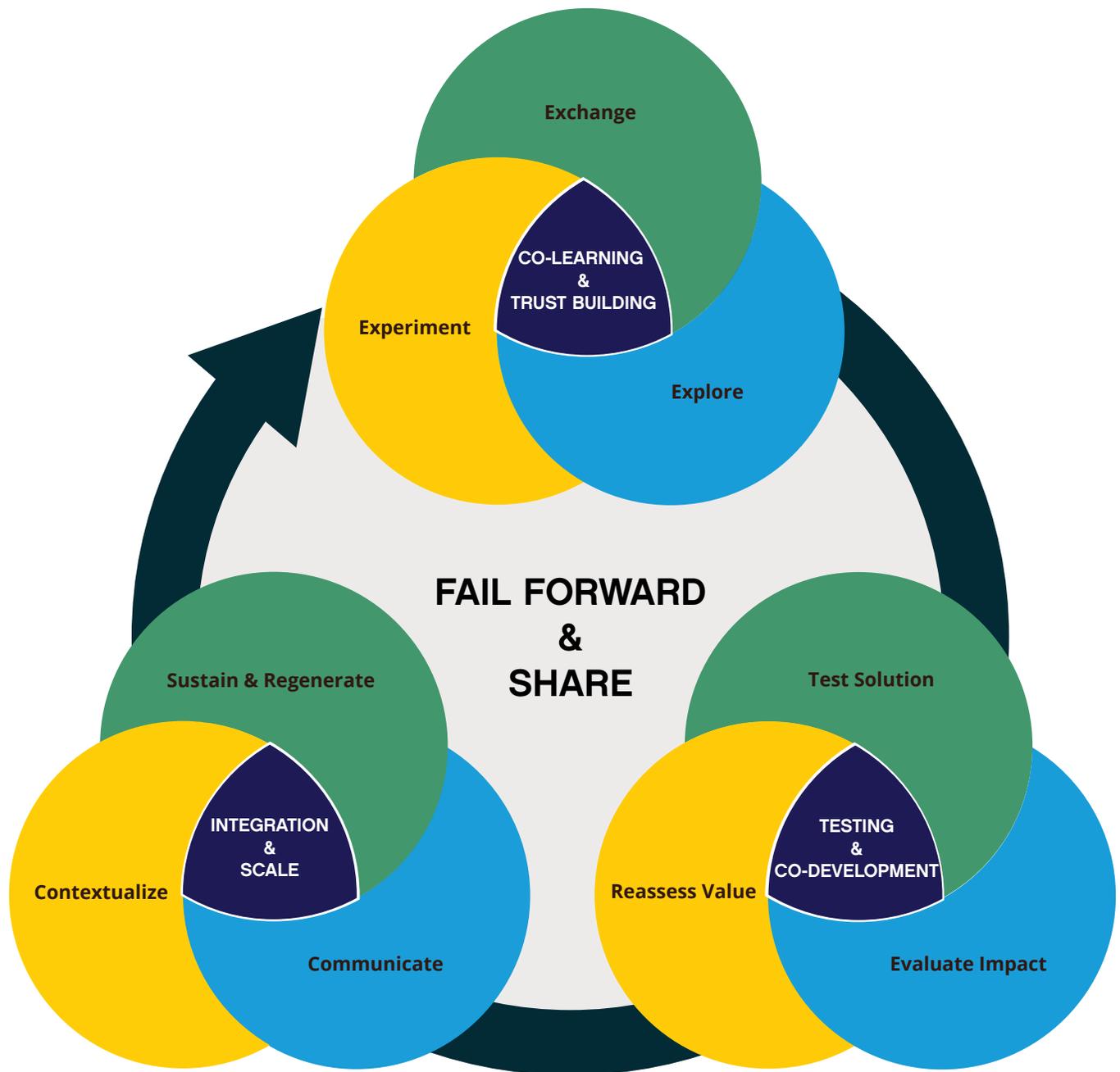
Figure 2. Strategic Framework for Philanthropic Interventions in the Digital Age: Entry Points for Supporting Transformative Climate Governance. This framework was developed based on inputs collected from the project's consultation sessions with experts from climate governance, technology and innovation, philanthropy, and other finance communities.

Co-learning and trust building
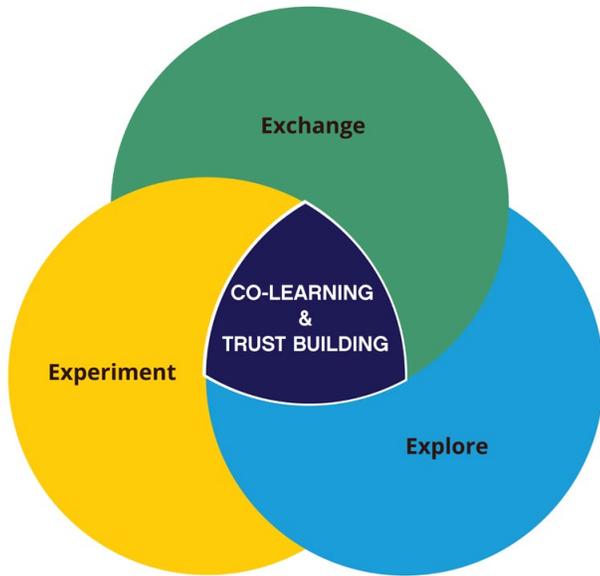
Designing safe spaces to bridge disconnected actors at the intersection of digital technology and climate governance, where they can identify and build on shared values and interests, is key to forming trusted relationships. Investing in this type of social capital for trust [41] is crucial in transforming the climate governance system [15,42-47]. Trust, diversity, and inclusion [48] are central to unleashing the transformative power of smooth partnerships and collaborative learning processes that leverage both human and machine intelligence and incorporate multiple knowledge systems and ways of knowing into the development of new solutions.

Exchange: Safe, inclusive, and accessible convening spaces can create opportunities for honest communications and the exchange of knowledge and experiences. This can be achieved by connecting across different sectors and cultures, including those who hold the problems and those with different forms of insight into potential solutions. This can help increase collective awareness and literacy on the topics of climate governance and digital technologies and reduce disconnect between actors. The facilitation of these types of spaces is incredibly important to create an atmosphere in which actors, who might otherwise feel marginalized, feel empowered to share their perspectives and contribute to a real, multi-directional learning environment.

Explore: Allow actors that might otherwise operate in competition or in isolated silos, to gather without the pressure of competition. This creates a pre-competitive space to collectively explore challenges and opportunities in climate governance, build trust, and establish new and diverse collaborations. Increased connectivity and engagement across societal actor groups can reduce the risk of disassociated digital solutions to climate mitigation while also opening up opportunities for creativity and the integration of different value systems and norms.

Experiment: By increasing engagement with a diversity of actors and gaining access to resources and technologies, initiatives can experiment and pilot new or revised projects and share all their failings and lessons learned with peers, without the pressure of competition. It also becomes possible to experiment with new forms of collective intelligence and models to develop and build out a digitally enabled climate governance strategy. This includes the incorporation of enabling conditions for systems change into the earliest design stage.

Testing and co-development
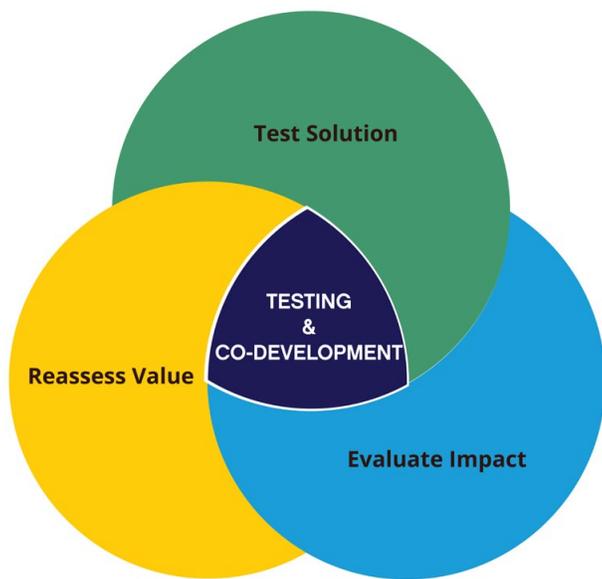
New and effective investments to support iterative testing and co-development with diverse stakeholders should be explored by funders. This includes funding with longer and flexible timelines and iterative yet less stringent reporting requirements and mechanisms to de-risk sustainability related initiatives [49]. A shift in valuation and impact assessment of these initiatives can also widen the reach and increase inclusivity of these solutions. The need for these newer funding strategies and a re-valuation of our financial and social systems have also been reflected by many others in different spaces of philanthropy and growth [40,46,49-52].

Test: Contextualizing and testing solutions with stakeholders and incorporating a broad spectrum of feedback at the early stages of development can help increase trust and confidence in the solutions, strengthening uptake at the implementation stage. Opportunities to test solutions should also be promoted and trialed with alternative funding mechanisms that reduce costs and risks. For example, blended finance mechanisms, where philanthropy can invest in and de-risk sustainability related initiatives by covering initial financial costs and losses (including cost of technologies and failure), can make these opportunities more attractive to new investors. This also provides actors with the necessary time and capacities to develop and test the digital solutions. In addition, mechanisms to invest in a broader range of smaller-scale initiatives should be explored as these initiatives are often overlooked because they require smaller initial investments and thus more

time to evaluate and follow up on per dollar investment as compared to larger efforts.

Evaluate impact: Applying inclusive, just, and otherwise ethically-sound evaluation criteria to digitally enabled climate solutions can help avoid contributing to existing inequalities. Some key requirements to consider when evaluating digitally enabled climate solutions include:

- **Involvement of local actors:** Are local actors leading the initiative? Are the leading actors agile and willing to take risks?

- **Scalability:** Can the solution be scaled in pre-competitive spaces where impact is prioritized over profit? Can it expand across wider regions with new forms of collaboration over time?

- **Third party data validation:** Is data undergoing third party validation and verification to reduce bias?

- **Data accessibility:** Can key stakeholders easily access and understand the data? Is there equal and distributed ownership of data?

- **Transparency**: Is it clear what technologies are being leveraged, through which means, and to what ends?

- **Wide distribution of benefits:** Are benefits accrued by stakeholders beyond funders? How do outcomes impact pre-existing power dynamics?

Reassess value: A considerable culture shift in the conceptualization of values is required to pursue transformative climate governance. This shift includes prioritizing and valuing multiple forms of capital beyond only produced capital including natural capital (all renewable and non-renewable resources), social capital (networks and cooperation), and human capital (knowledge and skill sets). Understanding and leveraging our interdependencies, including multiple forms of capital, and prioritizing their regeneration is central to accelerate and support necessary transformations to sustainability. Further, adaptive leaders that mobilize citizens to undertake challenges and **advance transformative solutions** should be more highly valued across sectors and geographies [53]. Supporting their well-being and long-term capacity to engage meaningfully is a critically underrated aspect of testing and developing initiatives.

Integration and scale
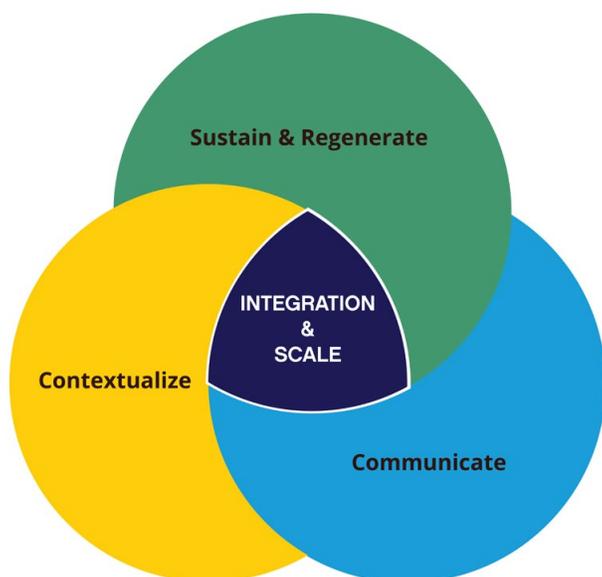
The long-term viability of an initiative and its application to multiple contexts are critical components of the development cycle. Building financial sustainability beyond philanthropy [54] and being accepted by all engaged and impacted stakeholders are central to long-term viability. When scaling an initiative, it is of the utmost importance to recognize that there are no cut-and-paste solutions and understanding how an initiative operates in a given context, in close collaboration with all relevant stakeholders, is thus critical.

Sustain and regenerate: A longer-term vision for digitally enabled climate governance initiatives (see Chapter 3 for examples) is to eliminate their dependence on donors and to transition to a model that is regenerative and self-sustaining. This calls for innovations in the ways in which business models and theories of change are conceptualized. Rather than a theory of change that requires consistent inputs of resources, or a business model focused entirely on profit over impact, it is possible to merge the two. Doing so can yield new types of change models that contribute not only to achieving project impacts but also to the development of a regenerative economy, while also planning explicitly for an exit strategy insofar as financial and other forms of resource requirements are concerned.

Communicate: It is increasingly critical to decomplexify,

integrate, and communicate data in a positive and engaging manner (e.g. storytelling). This helps make data and technology accessible and functional which can help change mindsets, increase confidence, and support a stakeholder's deeper integration in climate action. While digital literacy certainly plays a role, decomplexification is key to accelerating flows of information from the bottom up for more effective and agile governance at all levels. It can also support the development and empowerment of leaders who can harmonize digitally enabled solutions across different value systems and knowledge systems, as well as across sectors, scales, and geographies. Building the needed infrastructure and capacity amongst actors across all levels to operationalize the ever-increasing amounts of data being made available is also critical to ensure benefits are realized.

Contextualize: Assessing the appropriateness of the different aspects of an initiative to local socio-cultural contexts is key to understanding how to scale an initiative by implementing it more broadly. Adapting an initiative that has demonstrated success in one location to new local contexts requires understanding lessons from initial implementation. In other words, the key to scaling an initiative is hyper-contextualization. Critical steps to scaling, from this perspective, include closely engaging actors with boots on the ground, increasing local ownership over data collected, involving data owners in decisions over how data is ultimately stored and shared, and acclimatizing the solution to governance at the micro level, including the rules, norms, and expectations at the ground level.

3. Digitally Enabled Climate Initiatives in Action

"The growing integration of digital technologies in our world creates more interdependencies and connectivity, impacting all facets of our societal, economic and governance systems. There is an urgent need to create reformed cooperation and collaboration structures to build trust amongst all actors across every sector and to accelerate our climate action efforts."

– Karsten Schulz, PhD, Assistant Professor & Coordinator, Climate Adaptation Governance, University of Groningen

The Digital Climate Projects Database

To provide examples of different applications of digital technologies to climate action and to better characterize the types of actors involved, the project team developed and published a Digital Climate Projects Database. This collection of digitally enabled climate initiatives or projects around the world was compiled through a systematic web search [55] and a public call out for projects that fulfill the following three guiding criteria:

1. Help reduce the sources or increase the sinks of greenhouse gas emissions
2. Leverage digital tools with disruptive potential[3]
3. Aim to influence, impact, or inform governmental and/or non-governmental decision-making processes

A total of 210 initiatives were identified and evaluated.

The most frequently deployed technologies within these initiatives included remote sensing (satellites, drones and sensors) (28%), mobile technologies and digital platforms (27%), AI and machine learning (22%), and blockchain (14%). Initiatives that leverage digital twin technologies (modeling physical entities to assess real-world impacts) and smart grids (new types of energy grids that are equipped with various digital technologies to allow communication between the energy supplier and a consumer) were also identified in the database.

The database highlighted that digital technologies are being used for a diverse range of applications that contribute to climate mitigation. These included biodiversity and landscape conservation, carbon markets, sustainable agriculture, air quality improvement, renewable energy application, energy optimization, policy making, and Environmental, Social and Governance (ESG) reporting. Although many types of actors engage in these initiatives, including academic and research organizations, civil society, national governments, and partnerships involving different combinations of actors, the analysis showed that private sector actors lead (52%) and fund (54%) the majority of initiatives.

While most initiatives provide services in more than one geographical region, those initiatives operating in only one region were concentrated in Europe (13%) and North America (11%) as compared to South America (6%), Asia (6%) and Africa (5%). Furthermore, more than half of the initiatives operating in Africa and South America (64% and 54%, respectively) are led by actors headquartered outside of the respective region. This stands in stark contrast to the fact that no initiatives operating in North America are led by actors outside of that region and only 4% of initiatives in Europe are led by outside actors. For more information and to explore the full database visit https://sustainabilitydigitalage.org/digital-climate-projects.

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3   As classified by the D^2S Agenda [6] that recognizes four digital disruptors that are rapidly impacting society: unprecedented transparency, intelligent systems, mass collaboration, and mixed reality.

Major technology groups identified in the Digital Climate Projects Database (with examples)

Remote sensing (28%):

The use of satellites, drones, and sensors to collect various forms of environmental data.

Fairventures Social Forestry community agroforestry project adopts drone and cloud-based technologies to identify degraded spaces for agroforestry and to detect fire and deforestation risks. Through this, the project aims to reduce investment risks and improve the business model for community building and landscape restoration.

Mobile applications and online data platforms (27%):

The use of mobile phones and online platforms to increase connectivity as well as storage and accessibility of data.

StoveTrace allows households to accurately collect and communicate data on clean cooking stove usage through a mobile-based application and be rewarded for carbon emissions avoided by carbon market investors who are able to verify these reductions on a web-based platform.

Artificial intelligence (AI) and machine learning (22%):

The use of AI and machine learning algorithms to carry out a number of tasks, including automating data analysis, processing massive quantities of data, and identifying patterns [6].

Qube leverages AI and sensors to continuously monitor, detect, and analyse methane gas leaks in oil and gas facilities to rapidly and efficiently manage and reduce these leaks.

Blockchain (14%):

The use of digital transaction ledgers, that can be accessed and managed by a network of users, to store and track datasets in a transparent and secure manner [16].

Power Ledger is a blockchain-enabled platform that allows asset owners, operators, and consumers to rigorously track and trade renewable energy and other environmental commodities in a decentralized global market in real-time.

Pathways to transformative governance

By analyzing the 210 collected initiatives[4] in the database[5], the project team identified four broad strategies adopted by these projects to help achieve their goals and influence climate governance [55]:

- **Data mobilization to strengthen decision-making** – Capturing data to inform a decision-making process and increase transparency.

- **Digital optimization of existing strategies** – Using technology to increase efficiency of existing strategies and governance.

- **Incentivizing and automating behavioral change** – Incentivizing human behavioral change through targeted information sharing or rewards-based mechanisms or automating change by changing default options to sustainable alternatives.

- **Participation and empowerment** – Empowering the public to contribute to climate governance through open dialogues, direct participation in decision-making processes, new ownership models, and knowledge sharing initiatives (see page 19 for examples).

Stepping stones to impact

To explore the impact of each of these four strategies on transforming the climate governance system, we applied the Donella Meadows' framework for systems change (Figure 3). The left-hand side of the framework includes necessary enablers to change the system. For example, the required Parameters and Structures to collect data, pave the way for information exchange (Information Flows and Controls) in the center. Actions with the most ability to change the system (i.e. shifts in Rules, Power, and Mindsets) appear on the right-hand side of Meadows' framework [56]. Similarly, we classify our four identified strategies from left to right. Those on the left are the necessary enabling conditions for

those on the right that push stronger leverage points for systems change.

Namely, the strategies **Data mobilization** and **Digital optimization** act as stepping stones by setting up the necessary parameters and structures for data collection to increase interoperability, optimize high quality and granular data collection, and improve access to transparent, reliable, and accurate data.

The strategies **Incentivizing and automating behavioral change** and **Participation and empowerment** help catalyze transformative change within the climate governance system by influencing rules, mindsets, and power dynamics, for example through default sustainability options and by encouraging community leadership with the help of actionable data.

Philanthropy and other funding communities can work to establish links between different initiatives, bridging the enablers (on the left side) with the transformative initiatives (on the right). And all along the way, clear, accurate, and understandable data is crucial to changing beliefs and mindsets within the climate governance system, ultimately transforming the system.

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4   Although many steps were taken to reduce bias and increase inclusivity, the project team acknowledges that this database is not exhaustive nor complete. It is intended to serve as a starting point and to provide a snapshot of real-world applications of digital technology for climate action. The project scope does not extend to assessing the impacts of the initiatives within the database and is limited to evaluating web results on initiatives identified for the time being.

5   The database is a dynamic resource that will continue to grow and represent more initiatives. The analysis presented in this report is representative of the database as of February 11, 2022.
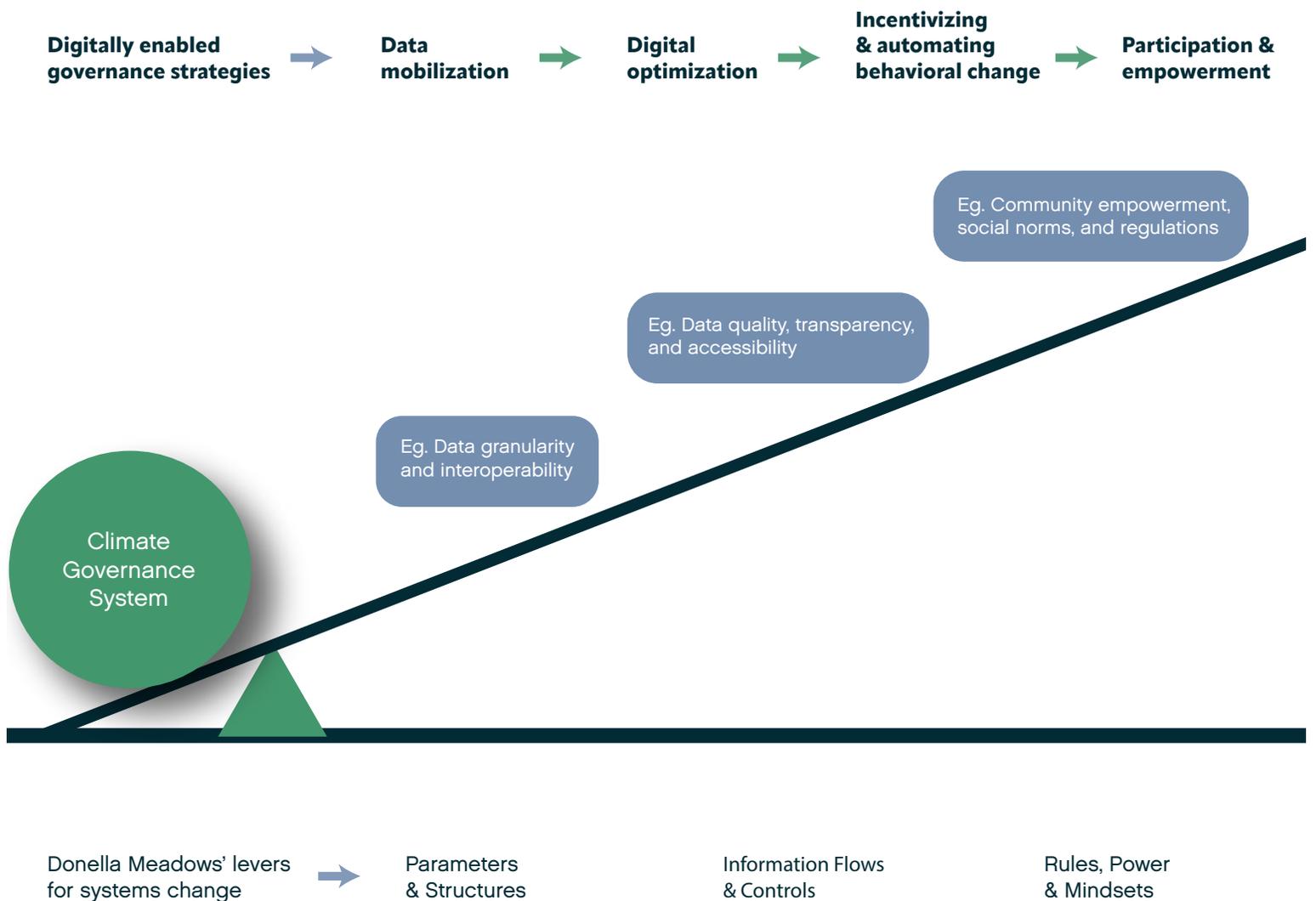
Figure 3. Mapping the digitally empowered climate governance strategies (top text, identified through analysis of the Digital Climate Projects Database) onto Donella Meadows' framework for systems change (bottom text). Through increased data granularity and interoperability, enhanced data quality and accessibility, and accelerating shifts in social norms and power dynamics, digital technologies can help transform the climate governance system.

This adaptation of the systems change framework was based on inputs from a series of iterative expert sessions.

Identified strategies of climate governance (with examples)

Data mobilization to strengthen decision-making:

Capturing data to inform a decision-making process and increase transparency.

Digital Green promotes data sharing between agricultural stakeholders, including farmers, experts, buyers etc, via mobile applications to support sustainable agricultural practices to increase productivity, reduce harvest losses, better preserve natural resources, and maximise profits to farmers. Farmstack, their latest application, helps build trust by re-imagining data sharing and allowing farmers and other actors to control how their data is shared.

Digital optimization of existing strategies:

Using technology to increase efficiency of existing strategies and governance.

ABALOBI Fisher mobile application, a digital fishers logbook, is optimizing traceability of fish catch for consumers, making it easier to reward and support sustainable fishing practices that help preserve vital ocean ecosystems.

Incentivizing and automating behavioral change:

Incentivizing human behavioral change through targeted information sharing or rewards-based mechanisms or automating change by changing default options to sustainable alternatives.

WattTime leverages predictive AI algorithms to automatically switch to cleaner energy sources whenever possible without compromising cost or comfort.

Participation and empowerment:

Empowering the public to contribute to climate governance through open dialogues, direct participation in decision-making processes, new ownership models, and knowledge sharing initiatives.

The Rainforest Alert initiative by Rainforest Foundation, is a forest monitoring program led by local communities and Indigenous groups. The program equips local actors with remote sensing technologies to monitor and detect illegal deforestation and provides community leaders with appropriate evidence to take action.

4. Reflections

"**Impact is hard. But it's not as hard as we've all led ourselves to believe. The key is the really impactful digital governance efforts have all been 10% technology and 90% listening. We must stop starting with the tech. And instead start with concrete emissions-reducing (or adaptation) actions we're hoping some concrete groups of humans will make. And then actually finding those specific humans and genuinely listening to what they say they need. It's usually not what others assume, which is the main reason most projects fail.**"

– Gavin McCormick, Co-Founder and Executive Director, WattTime

Key takeaways and future opportunities

The 2021 United Nations Framework Convention on Climate Change Conference of the Parties (COP 26) in Glasgow and recent international reports reinforce that current national pledges are not consistent with a safe and just future for the climate [2,4,57]. Knowing that digital technologies can be leveraged to accelerate the needed climate action, the *Re-imagining Climate Governance in the Digital Age* project explored how to develop digitally enabled solutions that are sustainable, inclusive, and can foster the societal transformations necessary to meet our climate goals. By connecting fragmented governance units across all levels and supporting collective action, digital technologies can help push governance systems into the 21st century. Still, it is critical not to treat digital technology as a silver bullet nor

to explore digital solutions in isolation from the societal and cultural contexts in which they are deployed.

The **Strategic Framework for Philanthropic Interventions in the Digital Age: Entry Points for Supporting Transformative Climate Governance**, built in consultation with experts in climate governance, finance, and digital innovation from around the world, can be used by philanthropy, other donors, and diverse actors as a guiding tool to shift towards a more agile climate governance system. Sharing of failures and lessons learned, implementing innovative funding mechanisms, promoting open data sources, data ownership and leadership by local communities and Indigenous groups, and building trust and cross-cultural literacy are some essential actions highlighted in the framework.

To add to this, the **Database of Digital Climate Projects** revealed the existing reliance on the private sector to lead work at this intersection and the dominance of global north actors, emphasizing again the need for more local leaders and technology transfers with the global south. The database also identified four key strategies through which digital technologies are currently being employed to gather clear and actionable data and enable changes to the rules, power structures, and norms that govern the climate system. These findings allow funding communities to provide more targeted support to actors and initiatives that are the building blocks of transformative climate governance.

Future opportunities to improve and continue the Digital Climate Projects Database include natural language processing to automate data collection or developing an interactive platform for actors in the space to connect with peers to build trusted relationships and increase knowledge, capital, and technology flows across geographies.

As a convenor, Sustainability in the Digital Age understands the urgent need to continue bridging disconnected actors

and facilitating knowledge transfers across the world to catalyze and accelerate transformative action. Convenings such as those held under this project, if conducted regularly, can help funding communities keep pace with the needs and priorities of the actors working at the rapidly evolving intersection of digital technology and climate governance.

Together with partners, the project team will continue to explore inclusive and just opportunities to leverage digital technologies to accelerate progress towards climate mitigation, biodiversity conservation, and other sustainability goals.

Figure 4. Throughout the project, questions were posed to experts in climate governance, technology and innovation, and funding communities, using ThoughtExchange. The above word cloud depicts the most cited words in response to the question:

"**What are the most critical factors that enable the viable application of technological solutions to climate governance challenges?**"

23 participants, 32 thoughts, 289 ratings

Appendix

Partial list of participants (total 54) for the project's expert consultation sessions.

* Brigitte Hoyer Gosselink, Google.org

* Frances M. Wang, ClimateWorks Foundation

* Kathleen E. Allen, Allen and Associates

* Shannon B. Olsson, the echo network

* Kelvin Diong, World Wildlife Fund Malaysia

* David Martin, The Martin Family Initiative

* Brendan Mapes, UNC-Chapel Hill/Data-Driven EnviroLab

* Fumiko Kasuga, Future Earth

* Nikita Japra, Patrick J. McGovern Foundation

* Shivam Gupta, Bonn Alliance for Sustainability Research (University of Bonn)

* Dermot O'Gorman, World Wildlife Fund

* Marco Schletz, PhD – Data-Driven EnviroLab and OpenEarth Foundation

* Chad Frischmann, Drawdown Solutions

* Katherine Foster, Social Alpha Foundation Fellow and Community Director Open Earth Foundation

* Jean-Christophe Laugée, InclusEO

* Guylaine Poisson, Information and Computer Sciences Department, University of Hawai'i at Mānoa

* Tamsin Jones, Small Giants Academy

* Serge Tuyihimbaze, Leapr Labs

* Pauline Koelbl, ShEquity

* Krishnan Pallassana, Digital Green

* Yasuhiro Murayama, National Institute of Information and Communications (NICT)

* Sylvain Carle, O13

* Claudia Juech, Patrick J McGovern

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