Rethinking SDG7: Current Gaps and Future Directions for Energy Access Beyond 2030

Perspectives of the 4TU Alliance on Energy Access

An interdisciplinary collaboration of the four Dutch technical universities

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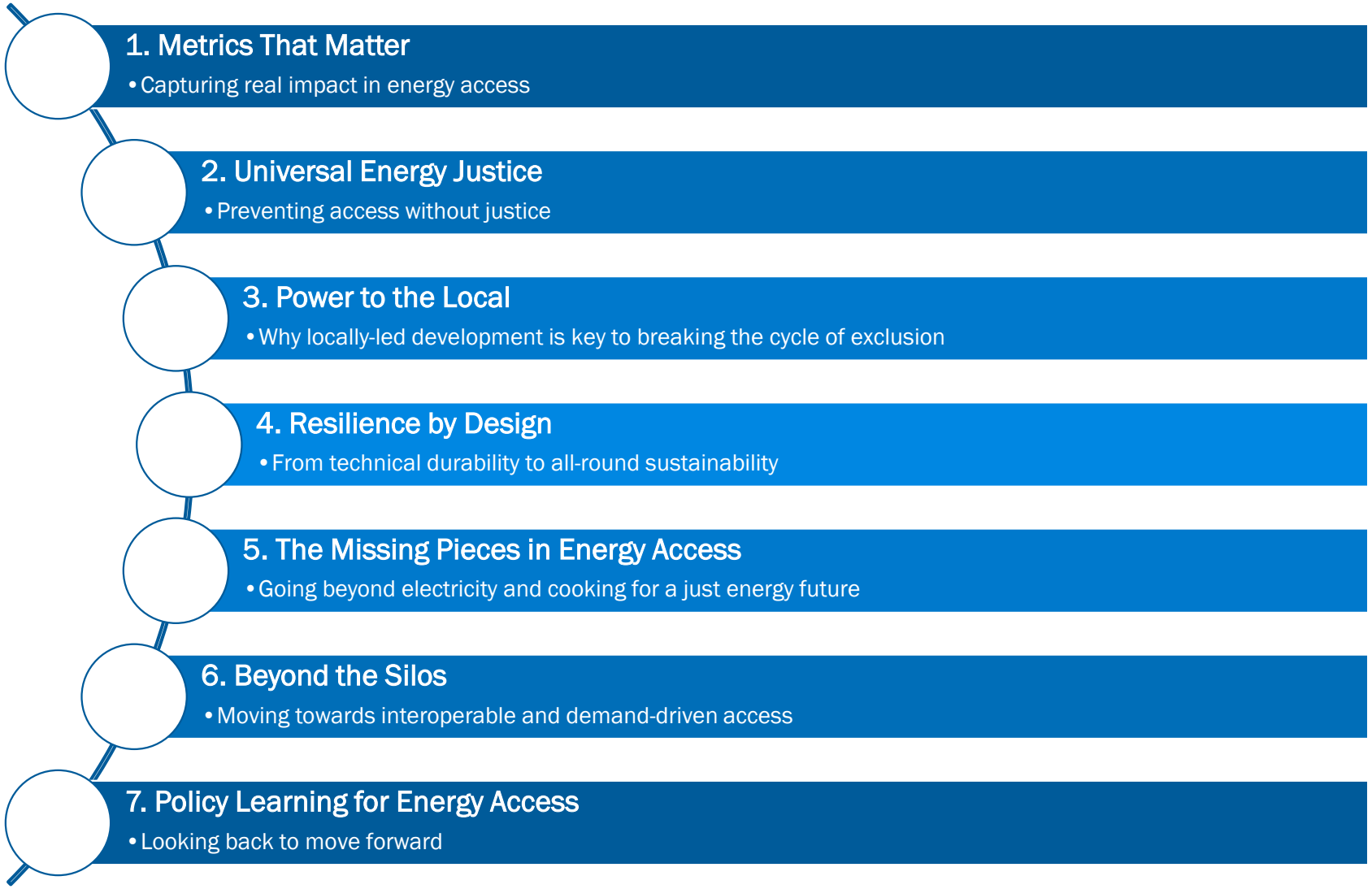
About this document

- As we approach the final stretch of the 2030 Agenda on Sustainable Development, we as the **4TU Alliance on Energy Access,** join ongoing discussions on the global stocktake and future directions of SDG 7. We contribute from our interdisciplinary perspectives by challenging the extent to which the SDG7 agenda has effectively delivered on its promises of scale, sustainability and impact.
- The **purpose** of this white paper is to:
  - reflect on progress and gaps in SDG7 achievement
  - inform strategic, reflexive policymaking for the post-2030 era
- We **advocate** for a shift towards more integrated, context-sensitive and forward-looking policies and strategies. These must recognize the complex realities of energy access and the role of energy as an enabler of social and economic development rather than the goal in itself, ensuring that policies and actions are not only technically sound but also socially just and resilient to future shocks.
- We provide a framework for reflection, appropriate action and stakeholder collaboration through **seven perspectives** that together advance **Just, Sustainable, and Resilient Energy Access** for all, now and beyond 2030.
- We **invite** policymakers, practitioners and scholars to engage with these perspectives, adapt them to their contexts, and work collaboratively to shape a more equitable global energy future.

Approach

- This document is the result of a **joint effort that synthesises decades of experience among an interdisciplinary and international team of scholars** based in the four Dutch technical universities of TU Delft, TU Eindhoven, University of Twente, and Wageningen University & Research (in brief, the 4TU Alliance on Energy Access). It contains seven distinct and connected perspectives on an effective agenda for SDG7.
- The researchers involved have been working on energy access across disciplines, geographies, scales, and sectors. **We integrate perspectives of our Global South partners** that we have and continue to work with. An advanced draft of this work was validated in a workshop held with researchers from Africa.
- Our expertise includes Chemical Engineering (Waste Management), Development Economics, Electrical Engineering (Power Electronics and Electromagnetic Compatibility), Environmental and Energy Management, Environmental Governance, Environmental and Public Policy Studies, History of Technology, International Development Studies, Philosophy of Technology, and Sustainable Energy Technology.
- To ensure as much inclusivity as possible, the steps followed in producing this paper include participation in the mid-term Global Stocktake for SDG7 and various consultation meetings with the Dutch Ministry of Foreign Affairs, Netherlands Enterprise Agency (RVO), scholars and practitioners from the Global South, the private sector, and collaboration with partners from a broader range of Dutch Universities.
- We acknowledge that our perspectives are, by necessity, constrained to our respective domains of expertise and those of the partners we engaged with and consulted. **We welcome new ideas and perspectives to this growing work.**
- This document presents our perspectives in a condensed format, highlighting the essence of our message. A more detailed and comprehensive version is currently being developed for publication in a scientific journal.

The Seven Perspectives



Perspective 1

Metrics That Matter

Capturing real impact of energy access

Tracking energy access progress: the problem

- Progress towards universal energy access is mainly tracked with simple short-term outcome-based metrics: numbers of people reached with clean/improved energy appliances and systems.
- Reasons include easy low-cost monitoring of progress, aid spending accountability, and political pressures to produce “hard” results quickly.
- Since the performance of donors, investors, companies and NGOs is mainly judged against these metrics, maximizing the numbers is what they are driven to pursue. However, this is in tension with the SDG principle of “leaving no-one behind,” since it takes substantive effort to reach the poorest and most remote. There are scarcely any rewards for efforts towards ensuring that energy access is sufficient, reliable, durable, and environmentally benign.

Recommendations

- SDG7 progress tracking needs to be redirected from capturing short-term outcomes geared towards assessment of developmental impacts, as there is no automatic positive causal link between them.
- This requires a mix of simple and more granular quantitative metrics and qualitative contextualized assessments, to capture the conditions needed for generating and reliably maintaining locally valued energy services and to track progress in reaching the poorest.
- Assessment should capture local/national capacities for assimilation, adaptation, design, construction, maintenance, repair, and environmental care of energy appliances and systems, and explicit insight into their affordability and accessibility.

What is improved energy access?

- We speak of improved energy access when
  - appliances and systems yield non-discriminatory and non-exploitative access to sufficient, reliable and affordable long-term energy services for improving people's quality of life (such as for better nutrition, education and healthcare),
  - the access yields realistic opportunities for strengthening livelihoods of disadvantaged populations, including youth with aspirations for a better future, and
  - it avoids the accumulation of toxic wastes, external technological dependence, and high debt.
- Establishing local (domestic) control and ownership of energy systems, resources and knowledge, is key to ensuring these conditions.
- Improved availability of clean and efficient energy systems is a necessary but not a sufficient condition for improved energy access.

Implications

- Impact-focused assessment that captures quality-of-life effects implies greater complexity in measurement and thereby increased effort. Effective approaches are needed to deal with this complexity while keeping costs and bureaucracy manageable.

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Perspective 2

Universal Energy Justice

Preventing access without justice

Energy access ≠ energy justice

- While universal access is a prerequisite for achieving energy justice, true justice requires more than the deployment of appropriate technologies.
- Often, the burdens of the energy supply chain go to disadvantaged communities, while the benefits are disproportionally distributed to dominant social groups.
- Energy injustices occur throughout and beyond the energy supply chain; from delving energy carriers and building materials, to manufacturing energy systems, distributing modern energy, and managing waste.
- Energy justice is too complex to be measured but can be assessed and operationalized through predictive assessments, reflection, recognition of specific communities and their needs, and allowing the participation of all relevant stakeholders.

What is energy justice?

Energy justice generally encompasses three dimensions:

- procedural justice (transparent procedures in which all relevant stakeholders are meaningfully included and allowed to participate);
- distributive justice (fair distribution of the burdens and benefits of the (global) energy systems); and
- recognition justice (recognizing that social groups have varying cultural, social, and political backgrounds that influence what kind of energy system they demand or reject).

Examples of hidden injustices

- Many “green” energy solutions have unjust consequences in the Global South. Nickel mining for batteries creates heavy pollution in New Caledonia, a significant part of the polysilicon used for manufacturing solar panels is extracted through forced labour in China, and even reforestation initiatives intended to remedy the ecological effects of energy poverty throughout the Global South have received criticisms of top-down approaches that marginalize local communities. Awareness of such burdens is crucial for operationalizing energy justice.
- Similarly, it is important to recognize that many resource-rich but energy poor countries have a colonial and neo-colonial history in which the benefits of modern energy--e.g., products, unfair profit margins, and overall project allocations—have been distributed to external actors, while the burdens of insufficient energy and pollution were borne by the local population.

Implications

- Operationalizing energy justice takes time, effort and (financial) resources.
- It may be more difficult for small- and medium enterprises to articulate a business case for including energy justice.
- There is concern that electrification is going too fast--without assessing local needs, risking environmental destruction, and allowing all profits to flow to foreign investors. Operationalising energy justice should prevent these.

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Perspective 3

Power to the Local

Why localisation is key to break the cycle of exclusion

No global without the local

- Distribution of benefits and costs within the global energy system is deeply imbalanced. Low- and Middle-Income Countries (LMICs) bear the environmental and social costs of resource extraction, while high-end production and economic value is captured elsewhere - mainly by industrialised nations. Opportunities for developing local industries, skills, and economies are thus missed.
- As long as we continue in the current vicious cycle in which LMICs remain as raw material, low-skill and low-value generating regions - while spending scarce resources to access technology, skills and investments – there will be no escape for the millions locked in this extractive model.
- Local potential and opportunities are missed with much wider development-impeding effects - not just for energy, but for education, jobs, innovation, and resilience.

Redefining locally-led approaches

- In locally-led approaches, emphasis is placed on local opportunities, benefits and solutions. Access is situated and is enabled or hindered by local access to technology, finances, markets and institutions.
- This goes beyond trickling down aid benefits to the local level, or repackaging priorities and goals from elsewhere into local contexts. It is about flattening the hierarchy of development architecture so that the local is an equal partner at all levels including in agenda and priority setting, capacity building and deployment and in benefit sharing across the whole global value chain.
- Currently, LMICs are burdened by historical patterns of extractivism and dependency, lack of a level playing field, and excluded yet exploited populations - most of whom constitute "the last-mile".

Strengthening and safeguarding local content

Properly understanding contextual factors - both those that enable or hinder access - is crucial to achieving energy access. These should include:

- Inclusion of local actors, ideas and initiatives on equal terms, including building local capacity to enable meaningful engagement.
- Improvements in access to technology; access to finance, markets and global value chains; access to information, knowledge and expertise; and access to key global and regional institutions and decision-making processes.

What's next?

We recommend:

- Global support for local policies that safeguard local innovations and markets.
- Localising profits and stimulating local industry development.
- Localising whole value chains to overcome external technological and financial dependencies, while shifting from low-value to high-value components at the local level.

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Perspective 4

Resilience by Design

From technical durability to all-round sustainability

Why resilience in energy access

- SDG7's current focus overlooks durability, which undermines progress as global challenges like population growth, climate change, resource scarcity, technology dependence, geopolitical tensions, social conflicts, and poor governance intensify the pressure on energy systems, leading to reduced resilience.
- Moreover, the current fragmented understanding of resilience focuses narrowly on technical durability and adaptability, overlooking the broader socio-economic and socio-ecological systems affected by energy infrastructure.
- A resilience-focused approach fosters sustainable, equitable energy access that can adapt to future challenges.

What is resilient energy access?

- A resilient energy system has the capacity to withstand shocks, adapt to changing conditions and transforms in response to external disruptions. It enables transition, security, stability, agility, and adaptability.
- Resilient energy access is multidimensional. It encompasses technical (infrastructure stability), social (well-being and equity), economic (affordability and local benefits), and environmental dimensions.

Strategies for energy resilience

- Integrating energy planning and innovative financing mechanisms aligned with risk reduction frameworks is essential for anticipating potential disruptions and designing adaptive infrastructure.
- Promoting decentralization of governance and technology, along with diversification of energy sources enhances the flexibility and reliability of energy systems.
- Strengthening and mobilizing local capacities to co-create context-specific solutions ensures that energy solutions deliver socio-economic benefits and are better aligned with local environmental conditions, encouraging environmentally sustainable practices.

Implications

- There can be trade-offs between building resilience and rapidly expanding energy access. A resilient energy system ensures long-term reliability and requires greater effort to implement. However, energy access initiatives often prioritize rapid deployment, sometimes at the expense of sustainability and resilience.
- Balancing resilience and speed is context-specific, requiring tailored strategies that align with local priorities, resources, and conditions. Effective approaches must consider factors such as geographical challenges, infrastructure, and community needs.

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Perspective 5

The Missing Pieces in Energy Access

Going beyond electricity and cooking for a just energy future

Why beyond electricity and clean cooking?

- While some stakeholders believe energy access is limited to electricity and clean cooking stoves, society also requires fuels for transportation and essential materials for daily life. Low quality waste streams from agriculture, food, wood, and municipal sectors represent a valuable local resource that can support a diversified and resilient energy system, empower communities and improve society and economic development.
- Clean cookstoves fall short as a long-term solution. These devices do not extend their utility to essential services such as lighting, heating, or productive applications like refrigeration, which are effectively addressed by modern bioenergy platforms, including mini-grids and biorefineries. Moreover, getting fuel for cooking stoves can be difficult in the Global South due to the often-fragmented distribution networks.

What is waste-to-value?

- Waste-to-value technologies are pivotal in advancing modern energy access through the transformation of organic residues into premium products. This approach is consistent with the overarching strategy of enhancing energy accessibility beyond just cooking.
- The current application of bioenergy in the Global South is at the lower end of its potential for generating heat alone, but waste can be used to make transportation fuels, bio-chemicals, and biomaterials. Waste-to-value technologies are relevant as they reduce landfilling, incineration, provide energy security and contribute to the circular bioeconomy.

Recommendations

- Clean cookstoves should be considered as an “interim step” towards modern energy systems, not the final step.
- Implement strategic incentives such as feed-in tariffs for biogas-generated electricity, soft loans for biofuel and biomaterial production facilities, and tax credits for waste-to-value investments. These steps, along with quality standards for biofuels and biomaterials, will direct private and public capital toward modern bioenergy platforms that will last beyond just using cookstoves and provide more energy services.

Implications

- It is important to ensure that companies do not exploit policy instruments solely for financial gain in response to the increased demand for clean cooking initiatives. This could lead to the spread of low-quality technologies with low social and environmental benefits.
- Enhancing institutional capacity, fostering coordination and participation among stakeholders, amplifying funding commitments, and formulating robust guidelines for biofuels/biomaterials and carbon trading are essential steps to develop and unlock the potential of sustainable waste value chains.

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Perspective 6

Beyond the Silos

Moving towards inter-operable and demand-driven access

Backward-looking and fragmented solutions

- Globally, there are increasing disruptions in electric power systems driven by rising integration of renewable energy sources, the accelerating demand for electrification, and rapid technological advancements. In practical implementation, these developments are converging the traditionally distinct policy domains of energy transition and energy access, despite their continued separation in global and national policy agendas.
- Electrification plans and scenarios are based on existing solutions (off-grid solar, mini-grid, and grid) and are driven by outcome-based agendas. This approach risks insufficiently leveraging technological advancements, leading to path dependencies and inefficient use of resources.

The mismatch

- Existing energy access supply approaches are struggling to match the demand, in terms of affordability, scaling, reliability of supply, business model viability and enabling improvement of livelihoods.
- Decentralised and centralised approaches are developing in technological and institutional silos risking becoming islands of viability and are leaving weak- and under-the-grid contexts behind.

Recommendations

- Energy policies should be forward-looking, driven by societal impact expressed in high-level attributes (e.g. economic development, improving health and education, enabling clean cooking) and incentivizing innovation to deliver on those attributes leveraging fast-cycle technology developments
- The mismatch between supply and demand in current energy access electrification approaches can be addressed by modular, interoperable, bottom-up solutions that grow with the demand, create local opportunities, and improve economic viability through value addition.

Implications

- Energy transition and energy access agendas should be brought closer in policy and implementation, cross-leveraging developments, learnings and resources.
- This requires crossing organisational silos, a longer-term perspective (beyond 2030 agenda) and different indicators of progress.

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Perspective 7

Policy Learning for Energy Access

Looking back to move forward

Are we learning enough from past policies?

- Progress on SDG7 varies widely across countries. While countries such as Bangladesh and Kenya have expanded energy access, many others continue to struggle.
- Public policy—deliberate government action to address a societal challenge—is a key driver of such outcomes. Despite contextual differences, past policies offer valuable lessons that can inform future policymaking.
- Yet, we lack systematic and comparative analyses of past policies, limiting opportunities for evidence-informed learning.

Illustrative case in Bangladesh and off-grid solar energy

- Collaboration with international agencies and the private sector helped the Bangladesh government launch an innovative Solar Home Systems policy.
- An integrated policy approach—combining financing, distribution, and service delivery—helped provide energy access to millions of citizens.
- However, subsequent policy changes and the simultaneous implementation of other initiatives tempered the early success of the initiative.
- Such cases underscore the value of studying how policies evolve over time, how different interventions interact, and which contextual factors influence outcomes.

What can be learnt from public policies?

Lesson-drawing is the process of learning from others to inform future policymaking. It involves identifying what worked (or did not), under what conditions, and how those lessons might be adapted to new contexts.

- Studying why and how governments adopt innovative energy access policies can reveal, for example, the roles of domestic leadership, international support, and social pressure.
- Analyzing how energy access policies interact with objectives such as energy efficiency, security, and climate can support more coherent and coordinated policymaking.
- Evaluating policy outcomes from multiple perspectives helps identify both successes and failures, generating insights for a more effective, context-sensitive strategy.

The way forward

- Systematic research into policy processes, designs, and outcomes is essential to building a valuable evidence base on energy access.
- Leveraging this knowledge can help stakeholders develop innovative, integrated, and context-specific strategies that respond to diverse local and regional challenges.
- The UN can play a catalytic role by establishing a global platform to track energy access policies, analyse their impact, and share the lessons learned. Timely dissemination of these insights can accelerate progress.

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Summary

Achieving **universal energy access** requires a fundamental shift in how we define, measure, and pursue progress in the **SDG7 agenda**. Current approaches are often fragmented and too often prioritize short-term, outcome-based metrics—like the number of households electrified—without capturing whether access is sufficient, reliable, environmentally sound, equitable, or transformative. To truly improve lives, we must measure **impact** of energy access in enabling social and economic development. This goes beyond access, for access alone does not guarantee **energy justice**. Many communities continue to bear the burdens of energy extraction, pollution, or inadequate technologies, while others reap disproportionate benefits. Operationalizing justice requires recognizing these inequalities, involving local voices, and addressing systemic imbalances throughout the energy supply chain.Many local governments, economies and communities struggle with **control over their own development**, rooted in historical patterns of extractivism and dependency, lack of a level playing field, exclusion and exploitation. Overcoming the last mile problem requires flattening the hierarchy of development architecture so that the local is an equal partner at all levels, including in agenda and priority setting, access to resources, capacity building and deployment and benefit sharing across the whole global value chain.

Energy systems must be **designed for resilience**, especially in the face of climate change, geopolitical conflicts, and supply chain disruptions. We should move beyond the current fragmented understanding of resilience, embracing a holistic view that encompasses technical, social, and environmental dimensions. That is why we must also **broaden our scope of energy access**. Sustainable and inclusive communities require more than electricity and clean cookstoves—they need diverse, circular and resilient energy systems, including bioenergy and waste-to-value technologies. However, strategies for energy access often rely on fragmented solutions that overlook the potential of new technological developments and local innovation. A forward-looking, flexible approach—grounded in **modular, interoperable systems**—can better respond to evolving needs and avoid locking communities into inflexible stop-gap solutions. None of this suggests that we should reinvent the wheel. We **can learn from past policy successes and failures** to accelerate this progress. By building on what works under what conditions, we can shape smarter, inclusive, sustainable and just energy policies that work now and beyond 2030.

Thank you.

We look forward to working together.

About us

- The 4TU Alliance on Energy Access was launched in April 2023,
- We are academics from the four Dutch technical universities, forming an interdisciplinary team.
- Our purpose is to shorten cycles between knowledge creation and innovation, policy making and mobilizing investments towards reaching impact at scale.

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