CIF CLIMATE INVESTMENT FUNDS

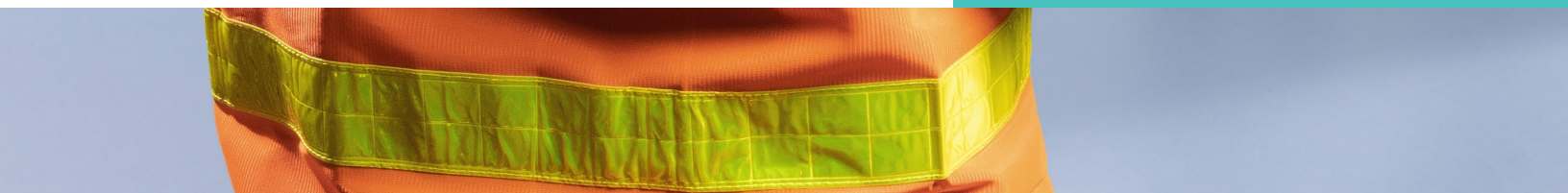
THE GLOBAL ENERGY STORAGE PROGRAM (GESP) LEARNING PLATFORM:

Sharing Knowledge to Transform Energy Systems

// May 2024

TOPICS

- Energy Storage
- Clean Transition
- Expansive Learning



ACKNOWLEDGMENTS

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1. INTRODUCTION

Energy storage plays a key role in accelerating the clean energy transition by providing a way to efficiently integrate intermittent renewable energy sources at scale. Many countries have vast solar and wind resources, and storage technologies can enable them to make the most of diverse energy sources to decarbonize electricity supplies and expand energy access. In 2020, the Climate Investment Funds (CIF) launched the Global Energy Storage Program (GESP) as a funding window under the Clean Technology Fund (CTF) to support developing countries in deploying innovative solutions to transform their energy systems. GESP is the world's largest multilateral fund for energy storage, with $431 million invested in 21 GESP projects to date mobilizing an additional $3.0 billion in public and private investments. In total, CIF has now allocated more than US$1 billion for energy storage, including through other CTF projects and planned investments under the Renewable Energy Integration program.

As part of its commitment to catalyzing investment in energy storage technologies in developing countries, CIF launched the GESP Learning Platform to promote knowledge-sharing and innovation. The GESP Learning Platform reflects CIF's mandate to serve as a learning laboratory for scaling climate finance, generating innovative and transformational solutions, and applying them at scale. This briefing paper provides an overview of the GESP Learning Platform and its approach to promoting mutual learning and innovation; synthesizes some key insights from the workshops conducted to date; and reflects on next steps.

2. THE GESP LEARNING PLATFORM

The GESP Learning Platform, coordinated by the CIF Secretariat, was designed to foster dialogue and facilitate knowledge exchange between the multilateral development banks (MDBs) and a wide range of stakeholders in the energy transition, including technical experts, private sector officials, local and national government institutions, and utilities, among others.

The goal was to provide a space to learn about energy storage technologies, share insights and lessons learned from projects around the world, and highlight the role of concessional finance in supporting early-stage storage operations in developing countries. Through their engagement in the platform, participants would also be able to identify opportunities to start deploying or scale up storage technologies through MDB partnerships and in-country engagements.

The GESP Learning Platform was launched in 2021, amid the COVID-19 pandemic, when in-person interactions were still limited but virtual tools flourished. The workshops used several online platforms, including Zoom and the online meeting and collaboration tools Gather and Mural.

The team worked to create inclusive and stimulating learning spaces, based on dialogue, collaborative brainstorming, social interaction, and sharing. The virtual setting enabled people from all over the world to join, which would not typically be possible in person. The diversity of participants created a rich learning environment, with examples from many different contexts that sparked discussions about how to adapt and scale up approaches from one country to another.

3. AN EXPANSIVE LEARNING APPROACH

The GESP Learning Platform has taken an expansive learning approach, guided by the pioneering work of Yrjö Engeström. Convinced that traditional top-down learning processes within constrained structures were increasingly ill-suited to societies' need for change, innovation, and transformation, Engeström developed a new theory of learning. This theory was based on the collective exploration of questions and ideas, with participants actively driving the process of knowledge creation, rather than passively receiving existing knowledge. From initial questioning to analysis, this learning approach does not end at modeling and implementing new solutions or approaches but reflects on it to learn for new practices.

This approach is particularly appropriate in the context of emerging technologies and new practices, as it encourages mutual learning, exploration, and creative problem-solving. Expansive learning is thus particularly well suited to the GESP Learning Platform, because the field of energy storage is still evolving, and the deployment of storage technologies at scale is still at an early stage, particularly in developing countries. The same is true for the business models and financing approaches required to accelerate and scale energy storage systems.

The process was designed as a sequence of iterative learning cycles that started with the facilitators and participants identifying challenges and opportunities in the field of energy storage that they wanted to explore, then building learning events around them. At each session, they shared emerging responses, pilots, and innovations; evaluated those solutions; and raised new questions.

The flexibility of the GESP Learning Platform and the sequencing of events enabled accelerated learning cycles for the creation and contextualization of new solutions. Each workshop picked up and explored emerging questions of common interest, such as how new business models function and how to access funding for energy storage.

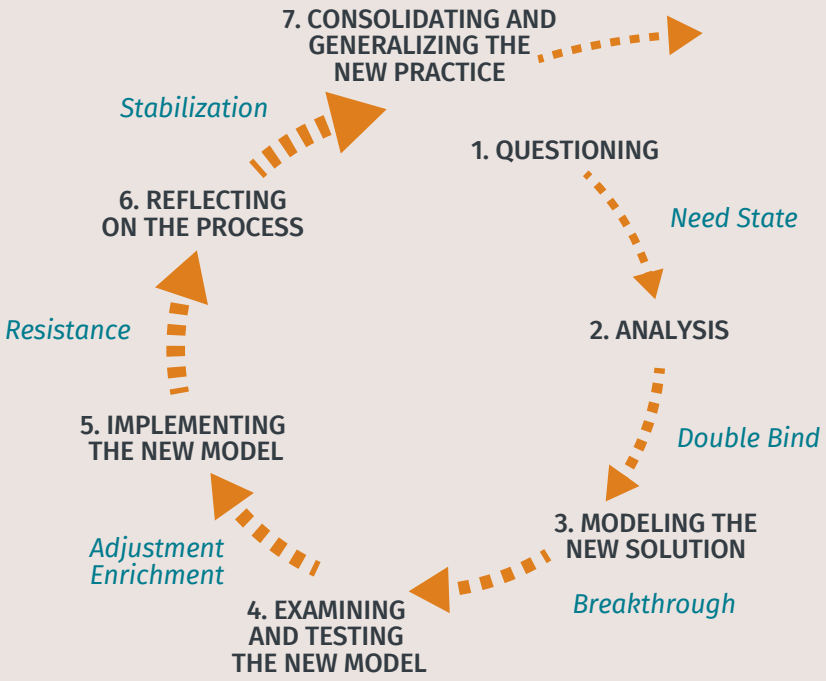

FIGURE 1. Expansive learning for shared exploration and innovation

Source: Engeström, 1999b, p. 384.

4. INSIGHTS FROM THE FIRST GESP LEARNING PLATFORM WORKSHOPS

The GESP Learning Platform has hosted three workshops to date in a series titled "Keeping the Power On," with hundreds of participants from more than 70 countries. The first workshop addressed questions and issues raised by the GESP program managers and key partners during initial engagements with countries on energy storage. The topic has gained prominence in recent years, but it was still quite novel at the time, so the first workshop focused on setting the stage for energy storage in relation to clean energy systems in developing countries.

Participants in that workshop were particularly interested in business models for energy storage (especially in early deployment stages), markets, and regulatory frameworks. The second workshop thus focused on building the business case for energy storage through examples from both developed and developing countries. This, in turn, sparked requests for a third learning event that focused on financing energy storage solutions. The rest of this section provides overviews of the three workshops.

4.1 Workshop 1: Sparking Energy Storage Solutions in Developing Countries

The inaugural GESP Learning Platform workshop was held over two half-days, on May 12 and 13, 2021.[1] It brought together MDB staff, policy makers, technologists, investors, project implementers, and development professionals to explore the challenges and opportunities of deploying large-scale energy storage projects across a range of technologies in the developing world.

Participants recognized that as steep cost reductions have enabled the accelerated deployment of renewable energy technologies, this has increased the need for energy storage systems and other mechanisms to support the integration of intermittent renewables into the power grid. They discussed an array of storage technologies, from batteries, to green hydrogen, to pumped storage hydropower.

A key takeaway was that **each country should aim to develop a portfolio of storage technologies tailored to its power grid's requirements and characteristics**, as illustrated in Figure 2. Combining different storage options can better meet different needs (e.g., short- vs. long-duration storage), but can also mitigate risks and increase the sustainability of decarbonization efforts.

In addition to well established technologies such as lithium-ion batteries, appropriate for short duration storage, and pumped hydro, more suited to longer duration storage, green hydrogen was also discussed as an important medium term storage option. As an emerging technology green hydrogen has high initial capital costs but offers a number of advantages including relatively low costs for scaling and longer duration (multiple days) storage. Green hydrogen is also seen as a valuable option in some hard-to-decarbonize sectors, such as steelmaking or heavy-duty transportation.

This discussion opened up considerations of diverse contributions that different storage technologies offer, the policy frameworks required to unlock the potential of these technologies, and the business cases for diverse and blended energy storage technologies in different contexts. In accordance with the iterative and expansive learning approach informing the GESP Learning Platform a second workshop was planned to explore these emerging themes in more detail.

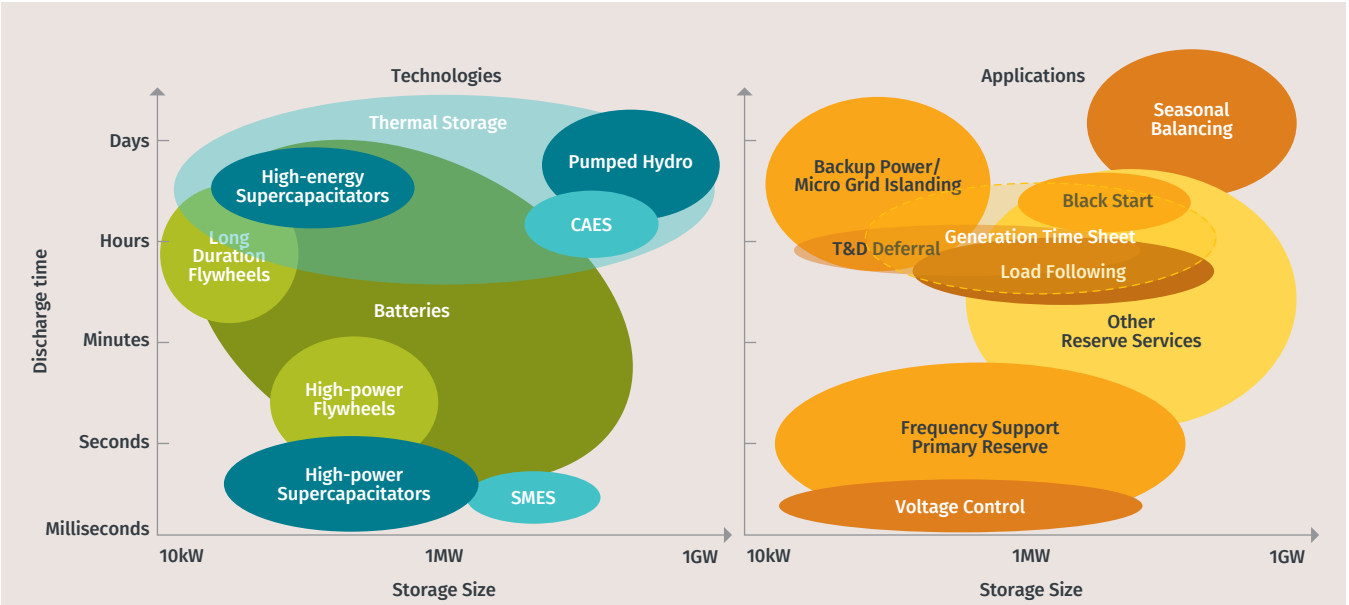

FIGURE 2. Energy storage technologies and their applications

Note: CAES = compressed air energy system; SMES = superconducting magnetic energy system; T&D = transmission and distribution.
Source: Reproduced from Figure 2.1 in ESMAP, 2020.[2]

4.2 Workshop 2: The Business Case for Emerging Energy Storage Technologies

Building on discussions at the first workshop, a second, half-day event was held on July 14, 2021.[3] Experts in energy storage technologies and practitioners shared insights and lessons from real-world energy storage development efforts, as well as frameworks, tools, and resources for getting the most value from energy storage to accelerate clean energy transformations.

A key issue raised was the need for policy reforms to enable the deployment of energy storage technologies and remove barriers. Regulatory frameworks need to be tailored to include energy storage systems, their applications, and interactions with other power services. **In other words, policy reforms are crucial for enabling storage technologies to contribute to accelerating and scaling up the decarbonization of the power sector.**

Countries' relevant regulations are at different stages, and there are opportunities to learn from one another's policy reform processes to enhance storage business models. Participants also highlighted the need to consider the role of energy storage in different aspects of the power system, including in improving the reliability of grids that are now weak.

In adapting their regulatory framework, participants said, countries should explore questions such as: (i) How is the grid managed? (ii) How can power systems in both developed and developing countries transition away from the traditional model of centralized assets? (iii) How can storage be deployed and managed on different grids under the same policy framework? (iv) How can we create systemic change that will enable power systems in developing countries to respond more efficiently to future changes and to shifts in supply and demand?

Another key takeaway of the workshop was that **markets should be redesigned for energy storage to monetize system benefits associated with the provision of a range of services.** In this context, global knowledge partnerships are a valuable resource

for regulators and policy makers, to help them understand all aspects of the value that a storage system adds to an entire energy system. One reason why storage technologies are still mainly being deployed in developed countries is because mature regulatory frameworks and market mechanisms make it possible to monetize the value added by storage. Developing countries have fewer open markets for energy storage deployment.

To unlock the full market potential of storage, participants said, it is critical to stack revenues by providing different services simultaneously. Energy storage can provide a variety of services to the grid at the same time, which can make it more economically viable. The services provided in a given context should be determined through an in-depth regulatory and market analysis of value opportunities.[4] Figure 3 illustrates an approach discussed at the workshop for designing a storage intervention. It visualizes each stage of the business model design for the deployment of agnostic storage technology.

Despite substantial evidence being shared of clear business cases for energy storage participants expressed frustration at the difficulty and complexity of unlocking sufficient and appropriate funding for the development of energy storage systems. A follow-up workshop was thus planned to explore how to mobilize finance at scale to deploy energy storage solutions, particularly in developing countries—where, as noted above, markets cannot yet deliver the returns that investors might seek.

4.3 Workshop 3: Financing Energy Storage Solutions

The third workshop, held on December 14, 2021,[5] considered financing from several different perspectives, and drawing on experiences from around the world. A key takeaway was that **mobilizing the required level of finance requires strong collaboration between governments, the MDBs, and the private sector.**

A 2021 report by the International Energy Agency (IEA) found that if the world is to reach net zero emissions by 2050, annual clean energy investment in developing and emerging economies needs to grow more than sevenfold in this decade, from less than US$150 billion in 2020 to more than $1 trillion by 2030.[6] Global investment in energy transition technologies has been growing rapidly, but except for China and, to a lesser extent, Brazil and India, developing and emerging economies are attracting only a fraction of the clean energy finance flowing worldwide.[7]

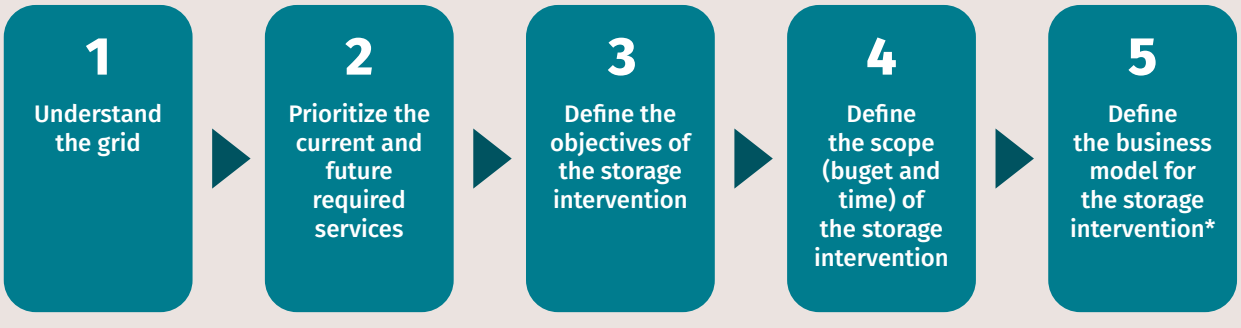

FIGURE 3. Process for designing a storage intervention

** Needs technology-agnostic analysis and the definition of payment mechanisms (e.g. pay for availability of energy storage, pay for the number of cycles needed, pay for the efficiency/performance the system gives you).*

The challenge, as framed at the workshop, is twofold: not only to dramatically scale up finance, but also to ensure that the finance supports the transformational change that countries need. Participants discussed what this would entail, including examples such as CIF's work in the Maldives—with the World Bank and the Asian Infrastructure Investment Bank (AIIB)—to accelerate the decarbonization of the power sector. It is important to keep exploring opportunities and emerging models for multi-partner finance to unlock and shape transformational investments in energy storage.

Another key takeaway was that **technological and market predictability is crucial for increasing transformational climate finance[8] for energy storage.** While storage can and often does improve the predictability of renewable assets, the operation of storage assets is not always predictable. With new storage technologies getting deployed in the market, their operation continues to frequently evolve. Thus, active management and strategic planning is required for the utilization of the assets of energy storage systems.

BOX 1. Catalytic investments to accelerate the transformation of the Maldives' power sector

The Maldives rely on expensive fossil fuel imports for their energy needs, at a cost of about 10 percent of GDP. Roughly half of those imports are used for electricity generation. On many of the smaller inhabited islands, electricity costs are as high as US$0.70/kWh, requiring heavy government subsidies to maintain energy access.

Each island typically has only about 5–15 MW of power generation capacity, and the diesel generators and grid systems on remote islands are now 20 years old and in need of replacement. Solar power could provide a cleaner and more affordable alternative, but the intermittency of solar means that storage technologies are key.

The Maldives have abundant renewable energy resources, and the government has committed to net zero emissions by 2030, so adopting solar photovoltaics (PV) together with battery energy storage systems (BESS) is an attractive solution. Informed by a detailed technical and economic analysis, projects were proposed that could substantially reduce power costs for consumers and utilities while also avoiding 445,000 tCO2 of emissions from 2020 to 2040. The value proposition is particularly strong where BESS can enable the integration of additional solar PV, which is already highly competitive against diesel generators.

The Maldives thus became one of the first countries selected to pilot projects under CIF's Scaling Renewable Energy Program (SREP). With a US$11.68 million grant from SREP and a $16 million guarantee from the World Bank, the ASPIRE project offered technical assistance, structuring, and delivery of tariff buy-downs for planned subsequent projects, as well as a financial risk mitigation mechanism. The latter was anticipated to catalyze private investments, mobilizing over $9 million of additional capital.

Under the first contract awarded under ASPIRE, in 2014, the price per kWh was US$0.21. As risk mitigation measures helped lower technology costs, prices dropped, to $0.109 in a contract awarded in 2020 and $0.098 in 2022. These are the lowest tariffs achieved to date in a Small Island Developing State (SIDS).

A second project, ARISE, has since been launched with support from CIF's Clean Technology Fund (CTF). It is a US$107.4 million project focused on solar PV, battery storage, and grid upgrades. A US$30 million CTF investment catalyzed $45 million of commercial financing and $20 million from the AIIB.

The project also showed how affordable solar PV and BESS combined can be, with costs estimated at $0.10–0.15/kWh. Moreover, along with enabling a scale-up of solar PV, BESS is critical for the Maldives' power system in terms of mitigating outages, providing spinning reserve, and facilitating the integration of electric vehicle charging. Two projects of 40 MWh are being put out to bid, supported by CTF. With an initial capital investment of US$80.4 million in solar PV and BESS, the Maldives is expected to save $30.23 million per year on fossil fuel imports.

5. CLOSING REFLECTIONS AND NEXT STEPS

GESP is a first-of-its-kind investment program that aims to enhance new storage capacity in developing countries, accelerate cost reduction, facilitate the integration of variable renewable energy into power grids, and expand energy accessibility for millions of people. Sharing knowledge, ideas, and experiences is central to advancing GESP's objectives, and this was the motivation to set up the GESP Learning Platform.

The platform created an environment that encouraged participants to share, examine, and expand on lessons learned from the diverse contexts in which they operate. By doing this, it helped to address a critical gap, as much of the current knowledge and learning on energy storage is focused on developed countries. There are very different challenges and opportunities in deploying energy storage in countries where the markets and regulatory frameworks are less advanced. This platform created a space for MDBs, governments, and other stakeholders to learn from each other's experience and to build a common ground on their energy storage knowledge needs based on their operations.

The GESP Learning Platform thus sets itself apart by supporting developing countries' distinctive efforts to adapt existing insights or develop new approaches to complex energy storage solutions. The expansive nature of the learning platform and its ability to identify and address contemporary questions through multiple events enabled deeper engagement with the immense market potential and the regulatory and grid challenges that developing countries are currently facing. GESP will continue to explore this dynamic market of new and current storage technologies and their applications to low and middle-income countries through combining and maximizing both its learning platform with the Renewable Energy Integration (REI) program one.

ENDNOTES

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→ 1 For an overview, the agenda, and videos of the full sessions, see: https://cif.org/cif_enc/knowledge-exchange/keeping-power-sparking-energy-storage-solutions-developing-countries

→ 2 ESMAP. 2020. "Deploying Storage for Power Systems in Developing Countries: Policy and Regulatory Considerations." Energy Sector Management Assistance Program. Washington, DC: World Bank. http://hdl.handle.net/10986/34400

→ 3 For an overview, the agenda, and a videos of the full session, see: https://cif.org/cif_enc/knowledge-exchange/keeping-power-business-case-emerging-energy-storage-technologies

→ 4 For a useful framework for such an analysis, see: IRENA. 2020. "Electricity Storage Valuation Framework: Assessing System Value and Ensuring Project Viability." Abu Dhabi: International Renewable Energy Agency. https://www.irena.org/Publications/2020/Mar/Electricity-Storage-Valuation-Framework-2020

→ 5 For an overview, the agenda, and a videos of the full session, see: https://cif.org/cif_enc/knowledge-exchange/keeping-power-financing-energy-storage-solutions

→ 6 IEA. 2021. "Financing Clean Energy Transitions in Emerging and Developing Economies." Paris: International Energy Agency. https://www.iea.org/reports/financing-clean-energy-transitions-in-emerging-and-developing-economies

→ 7 The latest data from BNEF show that in 2023, energy transition investments worldwide reached a record US$1.77 trillion, a 17 percent increase from 2022, with China alone accounting for US$675.9 billion; Brazil, for $34.8 billion, and India, for $31.4 billion. The top 10 economies and the European Union together accounted for 84.3 percent of total investment, however, while investment in all other countries—mainly, but not only, emerging and developing countries—totalled $277.3 billion.

See: BNEF, 2024. "Energy Transition Investment Trends 2024: Tracking global investment in the low-carbon transition." https://about.bnef.com/energy-transition-investment/

→ 8 The Transformational Change Learning Partnership (TCLP) has called for "transformational climate finance," defined as "an approach to financing climate action that prioritizes catalytic investments, promotes systemic changes in financial systems to align financial flows with the Paris Agreement, and delivers resources to climate investments that are climate-neutral, resilient, inclusive, equitable and sustainable."

See: CIF. 2023. "Principles for Transformational Climate Finance to Advance Just and Equitable Solutions." Transformational Change Learning Partnership paper. Washington, DC: Climate Investment Funds. https://www.cif.org/knowledge-documents/principles-transformational-climate-finance-advance-just-and-equitable-climate

THE CLIMATE INVESTMENT FUNDS

The Climate Investment Funds (CIF) were established in 2008 to mobilize resources and trigger investments for low carbon, climate resilient development in select middle and low income countries. Fourteen contributor countries have pledged over US$11 billion to the funds. To date CIF committed capital has generated an additional US$62 billion in co-financing for mitigation and adaptation interventions at an unprecedented scale in 72 recipient countries. CIF's large-scale, low-cost, long-term financing lowers the risk and cost of climate financing. It tests new business models, builds track records in unproven markets, and boosts investor confidence to unlock additional sources of finance. The CIF is one of the largest active climate finance mechanisms in the world.

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