



As the world strives to curb greenhouse gas emissions and scale up low carbon energy solutions, geothermal power holds tremendous promise as one of the most plentiful and cheapest renewable energy options available. While operational costs are low and consumer prices competitive, the 2014 global installed geothermal capacity of 13 gigawatts (GW) is a small fraction of the world's estimated 200 GW potential. Expansion is limited by the time and cost-intensive exploration phase that may reveal insufficient resources to generate power. Most private investors are not willing to take on these risks. Moreover, many countries lack the technological and performance records needed to secure commercial financing.

Established in 2008, the Climate Investment Funds (CIF) address these challenges by delivering investments at scale to empower climate-smart transformation.



\$810

MILLION
ALLOCATED TO
GEOHERMAL

- DE-RISK KEY PHASES OF GEOHERMAL DEVELOPMENT, INCLUDING EARLY-STAGE EXPLORATION AND DRILLING
- ESTABLISH A TRACK RECORD OF PERFORMANCE
- MOBILIZE PRIVATE SECTOR INVESTMENT



INVESTING IN GEOHERMAL POWER

The CIF is working to break down the barriers to geothermal power expansion by allocating \$810 million for geothermal investments in 15 countries. Over \$10 billion in co-financing is expected for a dynamic project pipeline with the potential to lead to the development of 3.5 GW of geothermal capacity, more than one-quarter of current global installed capacity.

The CIF is the leading source of international development finance for early-stage geothermal project exploration and development, providing \$400 million or more than half of total public finance currently flowing to these critical stages.¹

CIF funding is helping to expand markets in countries like Indonesia, Kenya, and Mexico and

is supporting some of the first large-scale geothermal projects in Armenia, Chile, Dominica, Ethiopia, and Tanzania. Developing these resources will not only help to lower greenhouse gas emissions and mitigate the effects of climate change, it will have a major impact on countries' energy security and independence.

CIF resources from its Clean Technology Fund (CTF) and Scaling Up Renewable Energy in Low Income Countries Program (SREP) are being used to:

- Remove investment barriers
- Create enabling environments
- Bridge funding gaps
- Innovate private sector finance

CIF INVESTMENTS IN GEOHERMAL

AFRICA
\$126.5 million
for 710 MW

ASIA
\$414.6 million
for 2,200 MW

EUROPE AND CENTRAL ASIA
\$73.8 million
for 79 MW

LATIN AMERICA AND CARIBBEAN
\$194.8 million
for 516 MW

\$810
MILLION
SREP & CTF ALLOCATIONS

CONTRIBUTING
TO POTENTIAL

3.5 GW

GEOHERMAL
POWER

OVER

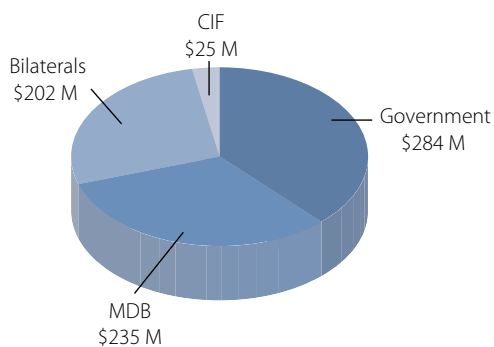
1/4

OF CURRENT GLOBAL
INSTALLED CAPACITY
13 GW

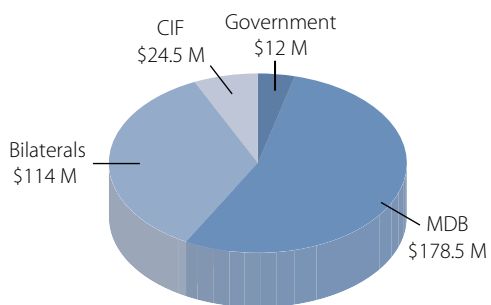




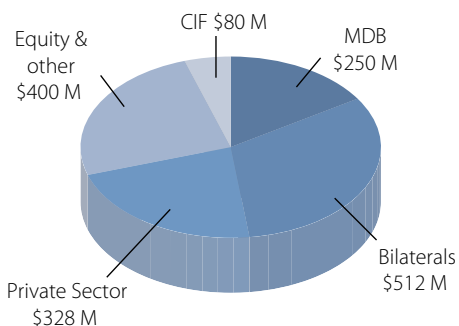
MENENGAI, KENYA
\$746 MILLION TOTAL PROJECT COST, 400 MW



ALUTO LANGANO, ETHIOPIA
\$329 MILLION TOTAL PROJECT COST, 75 MW



SARULLA, INDONESIA
\$1.6 BILLION TOTAL PROJECT COST, 320 MW



CIF IN ACTION

REMOVING INVESTMENT BARRIERS IN KENYA

In Kenya, a top government priority is to improve access to affordable energy. Approximately 65 percent of Kenyans do not have access to basic energy services, and existing energy supply is heavily and unsustainably dependent on hydroelectric power. To meet growing energy demand, Kenya is increasingly turning to other renewable energy solutions, particularly geothermal. Kenya has an estimated geothermal potential of nearly 7,000 MW—around three times Kenya’s annual energy use. As of 2014, installed geothermal generation capacity was 241 MW, but the government plans to increase it to 5,530 MW by 2030.

The SREP is supporting this effort by helping to remove investment barriers, such as exploration and drilling risks, to establish a strong basis for private sector participation in Kenya’s emerging geothermal energy market.

- SREP \$25 million, administered by the African Development Bank, is supporting expansion of the Menengai geothermal power plant by financing exploratory drilling. Phase I drilling is under way and expected to prove 400 MW, which developers aim to add to the national grid by 2017.
- Another \$20 million from the SREP private sector set-aside was allocated in 2014 to help finance the 140 MW Olkaria IV project, the first public-private partnership in the geothermal sector in Kenya. SREP financing will help cover payment default risk. If successful, this transaction could spark the beginning of a new paradigm in the financing of energy infrastructure in Kenya.

CREATING ENABLING ENVIRONMENT IN ETHIOPIA

Ethiopia is working to tap its estimated 5,000 MW of geothermal power potential. **With SREP support, it is developing a long-term geothermal energy strategy and investing in expansion of the Aluto Langano steam field** to demonstrate the technical and commercial viability of Ethiopia’s geothermal sector, reduce risk perceptions, and catalyze scaled-up financing in the future.

- SREP \$1.5 million channeled through the International Finance Corporation is supporting this effort with technical assistance in drafting or revising geothermal laws and regulations to provide a strong and transparent regulatory framework and a sustainable operational and institutional structure to govern private power generation.
- SREP \$24.5 million channeled through the World Bank will help cover the costs of surface exploration, drilling consumables, technical assistance, and capacity building needed to develop 75 MW of new geothermal capacity at the Aluto Langanu Geothermal Plant, established in 1998 as a 7 MW pilot to test steam resources.

BRIDGING FINANCING GAP IN INDONESIA

Indonesia aims to increase the share of renewable energy in its primary energy supply from 5 percent in 2010 to 25 percent by 2025. Current installed geothermal capacity is 1.3 GW, less than 5 percent of Indonesia's total geothermal potential, which is estimated at more than 29 GW. Regulatory barriers, inadequate feed-in tariffs, lack of financing and early stage exploration risks have frustrated exploitation of the country's large geothermal potential.

CIF financing from the CTF is facilitating commercial lending that is expected to lead five geothermal projects totaling 750 MW to financial closure, setting a benchmark for commercial bank lending. The CTF is also providing risk capital to help other projects complete the exploratory drilling phase of development.

In particular, CTF \$80 million, administered by the Asian Development Bank, is supporting the 320 MW Sarulla geothermal power project, the largest single-contract geothermal power project in the world.² Upon completion in 2018, it will avoid 1.3 million tons of CO₂ emissions per year and provide 500,000 households with access to clean energy. Given the few precedents in the sector and constraints in the capital markets, the Sarulla geothermal project has required an innovative finance structure to help address the risk profile of a first-mover private sector investment. Concessional funding from the CTF has helped bridge the financing gap between the commercial lenders and the equity investors and augmented the project's debt capacity. It also provided flexibility in connection with the timing of funding and payment under those facilities.

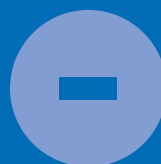
INNOVATING PRIVATE SECTOR FINANCE IN MEXICO

The Inter-American Development Bank is channeling **\$20 million of CTF dedicated private sector financing, along with \$34.3 million from Mexico's CTF investment plan, to support Mexico's national development bank, NAFIN, in implementing a geothermal financing and risk transfer facility designed to scale up investments in geothermal power generation projects.** Mexico ranks fourth in the world in geothermal electricity production at 958 MW of installed capacity. Yet this represents only 2.5 percent of the country's total power

generation capacity, and it is operated entirely by the state electric company, the Comisión Federal de Electricidad, with no participation of the private sector.

The risk transfer facility will provide a range of financial structures designed to meet the specific needs for each project's stage of development, including various risk mitigation mechanisms tailored to exploration, drilling, field development and construction, and operation phases. Expected results include 300 MW of new geothermal capacity and 33 million tons of CO₂ emissions reductions.

RISKS AND REWARDS OF GEOTHERMAL POWER



- High first mover costs
- Long development timelines
- High risk of exploratory drilling necessary for resource confirmation
- Countries may lack the technological and performance track record to secure commercial financing
- Banks may lack experience with the sector



- Stable, baseload energy to the grid, often operating at about 90% capacity rates
- Not impacted by variable weather, unlike hydropower resources
- Low greenhouse gas emissions
- Low operating expenses
- Competitive prices to consumers (levelized cost ~ \$0.09-0.13 per kWh)

PUBLIC FINANCE IS KEY TO UNLOCKING GEOTHERMAL POTENTIAL

Worldwide, up to 90 percent of geothermal project investments utilize some aspect of public debt or equity support. Innovative financial mechanisms are needed to de-risk geothermal development and increase private sector investment. As a “living laboratory” for climate finance, the CIF is learning by doing to find, refine, and share the most effective uses of public resources in advancing geothermal development.

The CIF has commissioned the Climate Policy Initiative (CPI) to undertake a body of analytical work³ leading to recommendations on how to effectively target public finance and public policy to scale up geothermal deployment. **While early public exploration and tendering of proven fields can attract private sector investment, research points to four more key areas of support:**

1. **Revenue certainty over a project’s lifetime** encouraged by supportive regulatory frameworks and clear deployment targets, as well as feed-in tariffs designed to shift operational risks and align to the project’s lifetime and financing liabilities
2. **Differentiated support in the exploration phase** to incentivize private sector participation where possible, such as when:
 - The private sector can manage these risks at the lowest cost
 - Survey data can be provided to support the exploration phase
 - Tariffs can be increased to reflect the developer’s exploration costs
3. **Long-term, low-cost debt** to free equity resources, decrease financing costs, and, in certain cases, ensure projects’ financial viability
4. **Risk mitigation to unlock financing**, including:
 - Government guarantees for off-takers
 - International financing institutions’ provision of political risk mitigation tools
 - International financing institutions’ support in acquiring technical capacity to bridge lenders’ knowledge gaps

CIF INVESTMENTS IN GEOTHERMAL



Notes

- 1 See <http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/Lessons-on-the-Role-of-Public-Finance-in-Deploying-Geothermal-Energy-in-Developing-Countries-Full-Report.pdf>
- 2 See <http://www.climateinvestmentfunds.org/cif/content/using-private-finance-accelerate-geothermal-deployment-sarulla-geothermal-power-plant-indone>
- 3 All CPI/CIF analytical work on public financing for geothermal power, including case studies, stakeholder dialogues, and reports, is available at www.climateinvestmentfunds.org.

Photos: World Bank Group

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