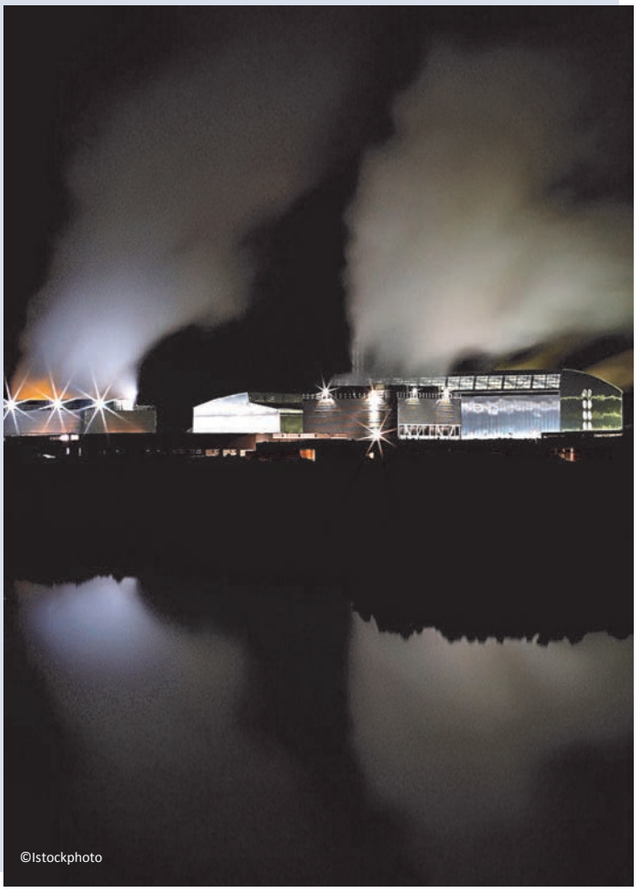
Global Geothermal Development Plan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ESMAP, the Energy Sector Management Assistance Program of the World Bank, is preparing a Global Geothermal Development Plan (GGDP) in collaboration with bilateral and multilateral development agencies and banks.

The GGDP will be transformational by creating global momentum in geothermal energy investments through a concerted focus on exploratory test drilling, the largest financial obstacle to geothermal energy scale-up.

The GGDP aims to identify, and facilitate financing for, a number of geothermal resource validation projects, as part of a portfolio large enough to generate global learning effects that will sustainably accelerate downstream investments in geothermal electricity production.

The GGDP seeks to mobilize around $500 million in concessional funding from diverse sources — bilateral donors, multilateral development banks, international climate finance (such as the Climate Investment Funds), and potentially in the future, the Green Climate Fund.

Geothermal Energy | A largely untapped potential for improving energy access and abatement of GHG emissions

Geothermal energy is a unique renewable resource with potential to contribute a significant share of low cost electricity supply in several countries. It is produced by exploiting the natural heat of underground water in deep reservoirs (1.5-3 km below ground) to produce electricity (and process heat) that can supply grids 24/7 to meet baseload and peak needs. Although geothermal resources are mainly located in regions of tectonic activity, about 40 countries in Central America and the Andean region, Eastern Europe, East Africa, Middle East, East Asia and the Pacific could satisfy a significant portion of their national electricity demand from geothermal energy. Accelerating the development of geothermal resources in these countries would strengthen energy security and provide access to reliable and affordable energy while avoiding greenhouse gas (GHG) emissions. A rapid acceleration of geothermal power development would serve to bend the GHG emission growth curve by avoiding decades of emissions from new fossil-fuel plants being planned in the absence of adequate information on geothermal resources.

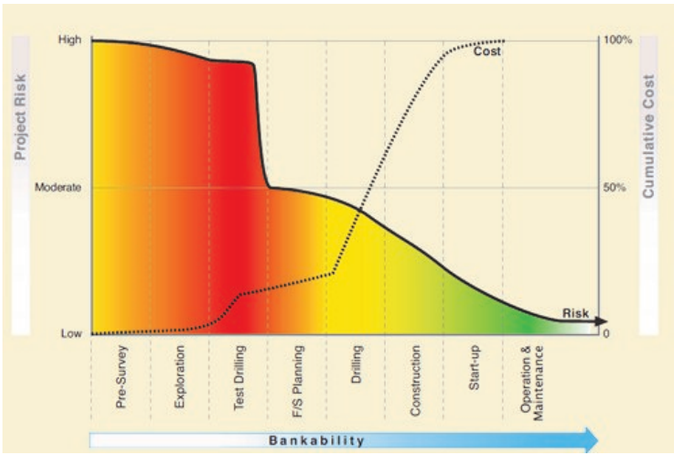
ESMAP
Energy Sector Management Assistance Program

Validating Geothermal Resources | A key barrier to geothermal development scale-up

In most countries where it is available, geothermal power can be a relatively low cost source of electricity—around US¢ 8 per kWh. When local and global externalities of alternatives are taken into account, geothermal energy often proves more economical than fossil-fuel alternatives. Yet, geothermal energy remains significantly underdeveloped because overcoming the resource risk is a large financial hurdle. Validating the availability of commercially viable geothermal resources through test drillings is an unavoidable step that often requires US$ 15-25 million per field, representing at least 10% of a new geothermal power plant's capital expenditure. The combination of relatively high capital requirements, high uncertainty of this phase, and the approximately 36 months needed to complete this resource validation phase deter commercial investors (see Figure 1). When private equity is available, it often results in increasing the final electricity tariff by US¢ 4-5 per kWh, due to the high expected return on the equity which remains at risk and without generating returns during the long gestation period.

As a result, this step is virtually impossible to finance without public support. This characteristic is similar to oil and gas drillings, but with the main difference being much lower prospects for rent in the case of geothermal energy. Once the geothermal resource has been proven, downstream investments in power generation have similar risk profiles to other steam-cycle electricity production.

Figure 1 | Geothermal Electricity Production Investment Cost and Risk Profile



Source | Geothermal handbook, ESMAP / World Bank 2012.

A Gap in the development and climate finance landscape for geothermal resource validations

In middle- and low-income countries, insufficient funding has been allocated to validate the availability of commercially viable geothermal resources. Most concessional funding and other support for public and private investments, including the Climate Investment Funds (CIF), have almost exclusively focused downstream (e.g., 94% of geothermal investments by MDBs over the past three decades have gone towards building steam gathering systems, power plants or geothermal electricity transmission infrastructure). This has resulted in a modest, stop-start expansion of the geothermal energy supply. To date, global installed capacity of geothermal electricity generation has reached only 11 GW, a fraction of its technical potential. According to the IEA World Energy Outlook 2012 projections, the share of geothermal electricity generation in world renewable electricity use will remain small if current levels of public support continue (from 1.6% in 2010 to 1.8% in 2020 and 2.3% in 2035). Countries, such as Indonesia and Kenya, where the geothermal energy resource base is large and promising, have taken years to secure modest geothermal electricity production capacities as development is constrained in large part by the lack of financing for resource validation.

Lessons from experience in supporting geothermal energy point to the need for a large scale global funding effort

Several key lessons from experience in funding geothermal development can be drawn:

1. Per unit of concessional funding, increased focus on resource validation (i.e., support to drillings expenditures and well testing activities) leverages larger investments in geothermal energy than downstream one-off investments in power plants.
2. Risk insurance instruments (such as the GEF-funded ARGeo or GEOFund) are often too small relative to the magnitude of investments required for resource validation. Moreover, risk insurance instruments are not a substitute for direct financing of resource validation, which remains indispensable given the constraints on capital availability in low and middle income countries.
3. Given the large unit cost of individual resource validation projects, sharing the costs among a larger number of donors is a more effective way to expand the pipeline of downstream investments.
4. To reduce the risk of drilling failures, maximizing learning effects through knowledge dissemination within and across countries is indispensable and can only be achieved if the global volume of drillings increases sufficiently to induce a sustained growth of the geothermal industry globally.

Objectives of the GGDP

In order to catalyze a large-scale global funding effort, ESMAP has launched the three-year GGDP (FY2013-15; at a cost of about US$ 5 million). The GGDP complements a partnership between the Government of Iceland and the World Bank/ESMAP which seeks to promote geothermal development in Africa through support for surface exploration that is necessary for the design of viable test drilling programs.

The objective of the GGDP is to scale up geothermal energy by addressing the resource risk through sustained international partnerships. To do so, the GGDP will prepare a pipeline of investment-ready geothermal resource validation projects, and help mobilize financing to undertake these projects.

A string of individual projects is feasible, but global leadership and monitoring through an initiative such as the GGDP will ensure better results

By helping to leverage a critical mass of concessional support to geothermal energy resource validation investments, the GGDP:

1. Provides a global partnership for all donors and other financiers to participate through different modalities (direct contribution to CIF, GEF, etc., co-financing, parallel financing).
2. Accelerates geothermal energy development as sufficient geological surface studies have been carried out to suggest that a pipeline of test drilling projects can be developed quickly (see Table 1).
3. Allocates the cost of test drillings across a wider group of stakeholders to spread the risks associated with such projects.
4. Enables a stronger global community of practice to emerge.
5. Helps expand opportunities for donor co-financing and parallel financing for individual resource assessment projects.
6. Paves the way for the identification of a pipeline of much larger commercial investment projects downstream (knowing that for each dollar invested in resource assessment, five dollars of capital are needed for the construction of the geothermal power plant; assuming a large 50% risk of failure in test drillings and a well productivity of 4-5MW per well).
7. Serves to broaden the reach of development partners and complements country level or regional efforts (such as KfW's GRMF for East Africa).
8. Stimulates drilling activity globally and increases drilling efficiency and learning, thus potentially reducing the risk of test drilling failures.
9. Increases the predictability that is needed for private sector involvement in development and accelerates implementation of regulatory changes needed to secure investors.

A key role for development finance and international climate finance

Individual projects of the GGDP can be financed in various ways. Some of the projects could be financed independently, mobilizing a variety of funding sources. This has already begun with the allocation of ESMAP co-funding for the Djibouti Geothermal Power project. However, as a large number of investment-ready opportunities of the GGDP are in countries which have already benefitted from support from the CIF (such as Mexico, Turkey, Indonesia, Kenya or Ethiopia), expanding some of the existing CTF or SREP investment plans would also be a practical approach to achieving the objectives of the GGDP.

Sharing risks amongst developers and donors

Support to projects of the GGDP would preferably be offered as soft loans (instead of grants), allowing reflows that could be reused for future GGDP projects in other countries or in subsequent phases of resource validation in a given country; and reducing the risks of adverse selection in supporting specific developers. Alternative financing instruments (such as contingent grants/loans or partially buying down the cost of commercial insurance) may also be offered in appropriate cases.

Risk sharing can take multiple forms, but would entail all stakeholders to extend support to cover a financing gap (for example combining CIF concessional support, incentives offered by the government of the recipient country and a reduced return on investment agreed by the project developer).

The Energy Sector Management Assistance Program (ESMAP) is a global knowledge and technical assistance program administered by the World Bank. It provides analytical and advisory services to low- and middle-income countries to increase their know-how and institutional capacity to achieve environmentally sustainable energy solutions for poverty reduction and economic growth. ESMAP is funded by Australia, Austria, Denmark, Finland, France, Germany, Iceland, Lithuania, the Netherlands, Norway, Sweden, and the United Kingdom, as well as the World Bank.

Table 1 | Examples of Potential Geothermal Fields (Hydrothermal) Technically Ready for Further Exploration Drilling

#	Country	Primary targets—Fields Where Sound Surface Exploration Has Been Completed But No Exploration Drilling Has Taken Place
Africa		
1	Kenya	Longonot
2	Kenya	Silali
3	Ethiopia	Corbetti
Latin America and Caribbean		
4	Colombia	Volcan Macizo Ruiz
5	Guatemala	Zúnil II
6	Mexico	Nuevo Leon Ejido
7	Nicaragua	Volcan Telica - El Najo
8	Nicaragua	Volcan Casita - San Cristobal
9	Montserrat	Soufrière Hill
Europe and Central Asia		
10	Turkey	Aydin-Umurlu
11	Turkey	Denizli-Tekke Hamam
12	Turkey	Manisa-Salihli
East Asia and Pacific		
13	Indonesia	Tulehu
16	Philippines	Batong-Buhay, Kalinga
17	Philippines	Mabini, Batangas
18	Philippines	Montelago, Mindoro Oriental

#	Country	Secondary targets—Fields Where Test Drillings Have Confirmed Geothermal Resource, In Need Of Development Drilling
Africa		
1	Kenya	Olkaria
2	Ethiopia	Aluto-Langano
Latin America and Caribbean		
3	Argentina	Copahue-Caviahue
4	Bolivia	Sur Lopez/Sol de M./Lag. Colorada
5	Chile	Puchuldiza
6	Chile	Tinguiririca
7	Chile	Laguna del Maule
8	Chile	Tolhuaca
9	Costa Rica	Borinquen
10	El Salvador	Chinameca
11	Guatemala	Cerro Blanco
12	Dominica	Wotten Waven
13	Saint Kitts &Nevis	Charlestown
Europe and Central Asia		
14	Turkey	Manisa-Alasehir
East Asia and Pacific		
15	Indonesia	Matalako Flores Island
16	Philippines	Mt. Cagua-Baua, Cagayan
17	Philippines	Daklan, Benguet
18	Philippines	Mt. Natib, Battan
19	Philippines	Mt. Labo, Camarines Norte
20	Philippines	So. Leyte