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GOVERNMENT INCENTIVES AND INTERNATIONAL SUPPORT FOR GEOTHERMAL PROJECT DEVELOPMENT

Ingimar G. Haraldsson
United Nations University Geothermal Training Programme
Orkustofnun, Grensasvegi 9, 108 Reykjavik
ICELAND
ingimar.haraldsson@os.is

ABSTRACT

Governments use various tools to support geothermal development in their countries. These include feed-in tariffs, renewable portfolio standards, tax credits, grants, loans, risk insurance, research, technical assistance, and exploration and resource assessment. On the international arena, bi-lateral and multi-lateral development institutions also support geothermal projects, mainly in the developing countries, through direct support, including technical assistance, capacity building, and grants, as well as through financing and risk insurance schemes.

1. INTRODUCTION

The State has an important role in initiating and supporting geothermal development in many countries (Haraldsson, 2012). Bilateral and multilateral development agencies also play a supporting role in some regions. The main channels for such support are discussed in the paper and examples presented.

2. GOVERNMENT SUPPORT TO GEOTHERMAL DEVELOPERS

There are various ways in which governments ensure support to geothermal developers through policies, programs and legislation. Many of these are touched upon in the following subsections.

2.1 Feed-in tariffs (FITs)

Where feed-in tariffs are in place for direct use (space heating) and/or electricity generated from geothermal resources, producers are guaranteed a price for the electricity that they provide into utility grids. Rybach (2010) informs that such tariffs are in place in many countries in Europe, including Austria, Belgium, the Czech Republic, Estonia, France, Greece, Slovakia, Slovenia and Spain, and that the system has led to large scale geothermal development in Germany. Gassner (2010) reports that the German Renewable Energy Sources Act of 2009 obliges operators of electricity supply grids to accept and give priority to electricity provided by renewable energy sources and to pay minimum prices stipulated by law for a 20 year period. The additional costs are passed on to consumers. In this way, Gassner notes, the State itself is not involved in financing, but instead merely controls the framework conditions, which allow project developers, investors and operators to reliably calculate yields for the first 20 years of operation.

The US federal Public Utility Regulatory Policies Act (PURPA) of 1978, which was implemented by individual states, obliged utilities to collect power produced by independent power producers and pay a tariff equaling the avoided costs of the utilities' own generation. According to Reed and Bloomquist (1995), PURPA has proven the single greatest incentive to geothermal development in the United States, by guaranteeing a market for electricity generated from geothermal resources. PURPA led to a dramatic growth in the number of geothermal projects in California and Nevada, where state public utilities aggressively implemented the act in the 1980s. About a third of the 2000 MWe installed during the decade came from plants in the two states taking advantage of PURPA.

Feed-in tariffs for geothermal electricity and heat are currently in place in 19 countries world-wide (REN21, 2014): Austria, Croatia, Czech Republic, Ecuador, France, Germany, Greece, Indonesia, Italy, Japan, Kenya, Serbia, Slovakia, Slovenia, Spain, Switzerland, Turkey, Uganda, and he United Kingdom (Figure 1).

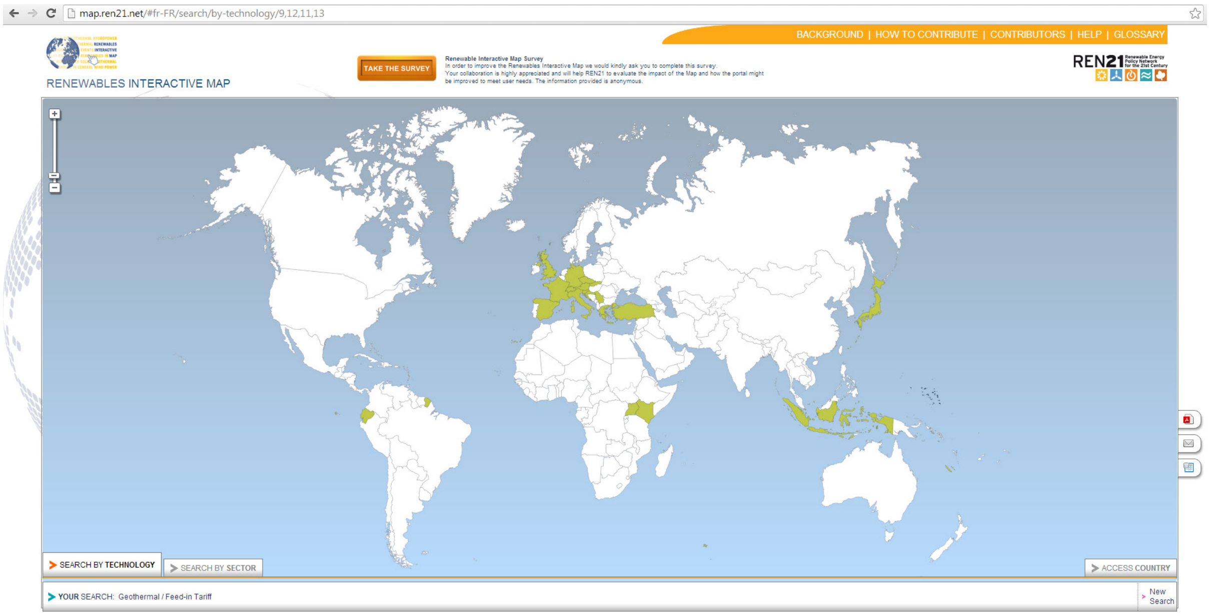

FIGURE 1: Countries with geothermal feed-in tariffs in place as displayed on the REN21 renewables interactive map (REN21, 2014)

Table 1 lists feed-in tariffs for electricity generated from geothermal power in selected countries with contract terms of 15 years or longer. The tariffs range significantly between countries, from 7.7 USD¢ in Uganda to 44.8 USD¢ for small geothermal power plants in Switzerland. Both Japan and Switzerland have more than one tariff category, depending on the size of the power plants. Geothermal feed-in tariffs above market rates were introduced in Japan in July 2012, in the wake of the Fukushima accident, to encourage project development (Watanabe, 2013). This shows how feed-in tariffs can be used as part of government policy to promote geothermal electricity generation.

2.2 Renewable portfolio standards (RPSs)

Renewable portfolio standards require that a certain percentage of utilities' electricity come from specific sources, such as renewables. The International Energy Agency's technology roadmap for geothermal heat and power states that renewable portfolio standards can be effective if they are sufficiently ambitious and binding for utilities – that is, if the financial penalties are set at appropriate levels in case of little or no compliance with the targets (OECD/IEA, 2011).

Miethling (2011) reports that Texas and Arizona employed renewable portfolio standards (RPSs) in 2001 and California followed suit a year later. California's RPS was accelerated in 2006 under a Senate

Bill by requiring that 20% of electricity retail sales be served by renewable energy resources by 2010 (California Energy Commission, 2011). In 2008, the goal was set higher as the state governor signed an executive order requiring that the proportion of electricity sales from renewable resources be increased to 33% by 2020. As of January 2012, 30 US states and the District of Columbia had enforceable RPSs or other mandated renewable capacity policies as shown in Figure 2 (EIA, 2012).

TABLE 1: Feed-in tariffs for geothermal electricity in selected countries with contract terms of 15 years or longer (modified from Gipe, 2014)

Country	**Size of plant**	**Contract term**	**Price / kWh**	**USD¢ / kWh***
Ecuador[1]		15 yrs	0.145 USD	14.5
France[1]	< 12 MW	15 yrs	0.20 EUR	27.3
Germany[1]	All sizes	20 yrs	0.25 EUR	34.2
Greece[1]		20 yrs	0.15 EUR	20.5
Indonesia – Papua[1]		?	0.17 USD	17.0
Indonesia – Sumatra[1]		?	0.10 USD	10.0
Italy[1]	< 1 MW	15 yrs	0.20 EUR	27.3
Japan[1,2]	< 15 MW	15 yrs	42 JPY	40.9
	≥ 15 MW	15 yrs	27.3 JPY	26.6
Kenya[1]		20 yrs	0.20 USD	20.0
Slovakia[1]		15 yrs	0.195 EUR	26.7
Slovenia[1]		15 yrs	0.152 EUR	20.8
Spain[1]		20 yrs	0.074 EUR	10.1
Switzerland[3]	≤ 5 MW	20 yrs	0.40 CHF	44.8
	≤ 10 MW	20 yrs	0.36 CHF	40.4
	≤ 20 MW	20 yrs	0.28 CHF	31.4
	> 20 MW	20 yrs	0.227 CHF	25.4
Uganda[1]		20 yrs	0.077 USD	7.7

1: (Gipe, 2014); 2: (METI, 2012); 3: (Siddiqi and Minder, 2012)
* According to currency exchange rates on 26 February 2014

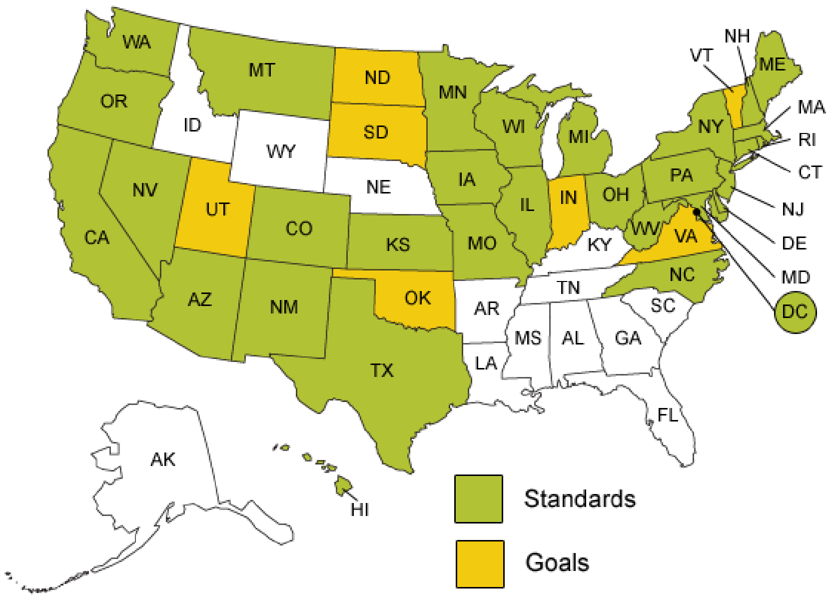

FIGURE 2: US states with renewable portfolio standards (mandatory) or goals (voluntary) in January 2012 (EIA, 2012)

Chile has also enacted an RPS through the Non-Conventional Renewable Energy Law, which requires providers in systems of an installed capacity of 200 MW or greater to demonstrate that at least 10% of the energy provided comes from non-conventional renewable energy resources by 2024 (Haraldsson, 2013). The Renewable Energy Heat Act in Germany obliges building developers to source a minimum percentage of the energy requirement for heating and hot water from renewable energy sources (Gassner, 2010).

Markets in renewable energy credits (RECs) have developed within some RPS schemes. The credits are assigned to eligible facilities on an energy unit basis (MWh) according to their output and are tradable (Fabri, 2009). The buyers are often utilities that need to meet the portfolio standard obligations, but RECs are also purchased by consumers who want to be ensured of the renewability and green marker of their energy.

Although RPSs can be found in various countries around the world, their popularity seems to have been greatest in the United States. However, in April 2013, 16 of the 29 states with renewable portfolio standards at the time were reportedly considering legislation to draw back mandates for utilities to buy renewable energy, after affordable shale gas became widely available in the markets (Martin, 2013). While such moves have mainly been directed at wind and solar power, they have the potential of proving detrimental to the geothermal energy industry if realized.

In addition to mandatory portfolio standards that stipulate penalties in the case of non-compliance, some countries have set non-binding targets for the share of electricity generated from renewables before a specific year, and many of these are related to the countries' commitments to reducing carbon dioxide emissions as a response to the threat of global warming. It is worth noting that where RPSs are in place, geothermal has in most, if not all, cases to compete with other renewables.

2.3 Tax credits

Various forms of tax credits exist to support geothermal development. Reed and Bloomquist (1995) inform that the 1978 Energy Tax Act established a 10% energy tax credit for investment by a business taxpayer in property used to produce, distribute or use energy from a geothermal deposit in the United States. This tax credit expired in 1990, but was later reauthorized. The American Recovery and Reinvestment Act of 2009 granted a federal renewable electricity production tax credit to eligible tax payers to generate electricity from geothermal resources through 2013 (IRS, 2009). Miethling (2011) notes, however, that small companies in the United States may have difficulties in making use of tax credits when facing a negative net income in the beginning of operations, and have therefore been forced into agreements with lending institutions to benefit from the credits.

In 2009, the Geothermal Energy Association published a study on US state and federal incentives for small power and direct-use geothermal production. It found that various tax credits were available at the federal and state levels at the time as shown in Figure 3 (Jennejohn, 2009). While the federal government only offered corporate tax incentives, the various states offered incentives through personal, corporate, sales, and property taxation. The implementation of these incentives varies significantly and the mechanics can be complex, which may result in difficult navigation for developers.

Peñarroyo (2010) reports that the Philippine Renewable Energy Act of 2008 provides various fiscal and non-fiscal incentives for renewable energy developers. These include an income tax holiday for the first 7 years of commercial operations of renewable energy facilities, special realty tax rates on equipment and machinery, net operating loss carry-over, accelerated depreciation, 0% VAT rate for the sale of renewable power, tax exemption of carbon credit sales, and tax credit on domestic capital equipment and services.

2.4 Direct support

Yet another way for the State to support geothermal development is through direct financial support in the form of grants and cost sharing. The US Department of Energy (DoE) has awarded grants for research and development, technical assistance, feasibility studies and demonstration projects, and provided cost sharing with industry on exploration, reservoir assessment, and reservoir engineering, in addition to releasing exploration data to the public (Reed and Bloomquist, 1995). Recently, DoE's Geothermal Technologies Program has granted millions of dollars to geothermal research and development projects in the US.

State	Personal Tax	Corporate Tax	Sales Tax	Property Tax	Rebates	Grants	Loans	Industry Support	Bonds	Production Incentives
Federal	-	+3	-	-	-	+3	+4	+	-	+
Alaska	-	-	-	-	-	+	-	-	-	-
Arizona	-	-	-	+	+3	-	-	-	-	-
California	+	-	-	-	-	-	-	-	-	+
Colorado	-	-	+2	+2	-	+	+	-	-	-
Hawaii	-	-	-	-	-	-	-	+	-	-
Idaho	-	-	+	+	-	-	-	-	+	-
Montana	-	+	-	+3	-	-	-	-	-	-
Nevada	-	-	+	+3	-	-	-	-	-	-
New Mexico	-	+	-	+	-	-	-	+	-	+
Oregon	-	+	-	+	-	-	+	-	-	-
Utah	+	+	+	-	-	-	-	+	-	-
Washington	-	-	+	-	-	-	-	-	-	+
Total	2	7	6	12	3	5	6	4	1	4

Legend:
- absence of that particular incentive in the respective state
+ presence of one particular incentive/program within the state.
+# more than one incentive of that particular type are available within the respective state

Source: U.S. Department of Energy, GEA.

FIGURE 3: Overview of US federal and state level geothermal incentives in 2009 (Jennejohn, 2009)

Wahjosoedibjo and Hasan (2012) inform that in its 2011 State Budget, the government of Indonesia committed to allocate the equivalent of USD 145 million to a fund dedicated to geothermal development. The purpose is to attract investment by sharing costs for initial exploration and to provide potential developers and investor with sufficient and credible information on green field geothermal sites that will be offered during the tendering process of new areas. Besides reimbursing interested parties with exploration costs, the provision of high quality information on pre-selected green field geothermal sites should help to reduce unknowns and alleviate risk aversion.

The Indonesian plan is in line with Rybach's (2010) recommendation that governments would finance the exploratory, and preferably also the pre-feasibility, phases of geothermal development, letting investors take over when it is known where to go. This methodology is also in line with past methodology of the Icelandic government, which funded geothermal exploration activities for decades for the benefit of the public.

Rybach (2010) also reports on the substantial financial assistance of the Australian government to new geothermal projects in the country in order to foster progress towards the commercialization of geothermal energy resources.

2.5 Loans

Governments may back or provide loans to the geothermal sector directly. The Icelandic government backed foreign loans with favorable interest rates to municipalities in the decades of geothermal development after World War II, which the municipalities might otherwise not have been able to secure (Björnsson, 1995). The Icelandic Energy Fund was established in the 1960s to provide low-interest loans to municipalities, firms or individuals for geothermal drilling and to share the risk of drilling with developers (Björnsson, 1995; Björnsson et al., 2010). The loans normally covered 60% of drilling costs and could be converted into grants if the development of a new geothermal field proved unsuccessful, thus also functioning as insurance for the developer.

A number of loan programs have also been authorized by the US federal government through the years. According to Reed and Bloomquist (1995), the best known of these was the Geothermal Loan Guarantee Program, which was authorized under the Geothermal Research, Development, and Demonstration Act of 1974. Loans for up to 75 percent of project costs could be granted under the act, with the federal government guaranteeing the full amount. In 2009, various loan programs were available at the federal and state levels according to Jennejohn (2009), as depicted in Figure 3.

Goodman et al. (2010) suggest that geothermal energy should receive low interest rate loans in the EU, in line with those available for the development of some other renewable energy sources.

2.6 Insurance

Due to the inherent risk in drilling for geothermal resources, insurance may be coveted by investors that do not have pockets deep enough to absorb the economic setbacks associated with drilling failures. The idea behind the Icelandic Energy Fund, besides granting loans for exploration and drilling, has been to provide such insurance. This has been achieved by turning loans into grants in case of failed attempts to develop new fields. Miethling (2010) reports that Germany has installed a similar drilling insurance where a premium is paid on a loan, which is converted into a grant in the case of drilling failure.

Rybach (2010) informs that a governmental risk coverage system has been in place in France since 1981. A short-term risk guarantee covers all or part of an investment in a well in case of drilling failure and a long-term risk guarantee covers the risk of resource decline for up to 25 years. A risk guarantee system was also established by the Parliament of Switzerland in 1986 and implemented by the federal government in 1987 (Rybach, 2010). The guarantee extended to 50% of drilling and testing costs and in specific cases up to 80%. A new governmental risk coverage system was introduced in 2008, in which the maximum guarantee is 50% of the subsurface costs. Goodman et al. (2010) suggest that geothermal risk insurance should extend to the whole European Union (EU).

2.7 License fees and royalties

Goodman et al. (2010) advice to keep license fees and royalties for the use of geothermal energy to a minimum within the EU and to keep them in perspective with fees and royalties for higher value resources such as hydrocarbons. According to them, the fees should take into account the return on investment. As geothermal resources within most countries of the EU are of rather low quality compared to the high-temperature resources found in many of the leading geothermal countries, it follows that they are also of lower economic value. In this way, governments can support the development of geothermal resources.

2.8 Easement of import duties

Peñarroyo (2010) has informed that one of the ways in which the Philippine Renewable Energy Act supports renewable energy development is to relieve developers from tariff duties on imported machinery and equipment. El Salvador has also lowered tariff duties on imported equipment for geothermal power plants.

3. INTERNATIONAL SUPPORT FOR GEOTHERMAL DEVELOPMENT

In addition and complimentary to the State, there are various bi-lateral and multi-lateral agencies and organizations that support the development of geothermal resources, primarily in the developing countries. While these institutions cannot influence development through legal and regulatory tools that apply within States, such as feed-in tariffs, portfolio standards, and tax credits, their strong backing by donor countries and capacity for pooling resources makes them capable of making a big difference in the geothermal development of many countries, whether through direct support, finance, or through the creation of drilling risk insurance schemes.

3.1 Direct support

Direct support includes technical assistance, capacity building, and grants.

An example of a technical assistance project is the Geothermal Exploration Project, which is funded and implemented by the Icelandic International Development Agency (ICEIDA) and the Nordic Development Fund (NDF). The aim of the 13 million USD project is to assist East African Rift System (EARS) countries in completing the exploratory phase of geothermal development and build capacity and expertise in the field of geothermal utilization and related policy (ICEIDA / NDF, 2013). The project is a sub-project of the Geothermal Compact partnership led by the World Bank, which in 2012 started to explore with other donors the possibility of mobilizing additional concessional resources to fund test drilling programs, after the activities of the Geothermal Exploration Project have been successfully completed (Figure 4). This initiative, the Global Geothermal Development Plan (GGDP) is led by the Energy Sector Management Assistance Program (ESMAP, 2013), which is a global, multi-donor technical assistance trust fund administered by the World Bank and co-sponsored by 13 official bilateral donors. A step in this direction was taken in October 2013, when the Clean Technology Fund (CTF), a program of the Climate Investment Funds (CIF), approved 115 million USD for the Utility Scale Renewable Energy Program, which will initially focus on facilitating private sector engagement

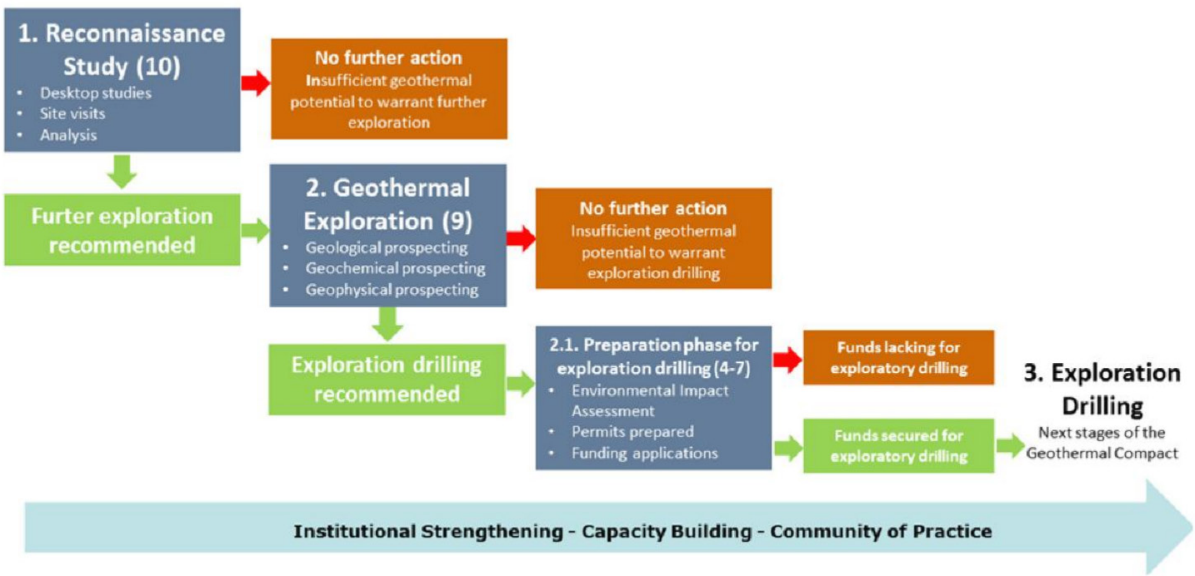

FIGURE 4: Workflow of activities within the Geothermal Exploration Project (color) precede exploration drilling, which may be supported through the GGDP or other channels (ICEIDA / NDF, 2013)

in geothermal resource validation through test drilling in four pilot countries: Chile, Indonesia, Mexico, and Turkey (ESMAP, 2014). The program is open to additional pledges to donors and is expected to expand to other countries, such as Ethiopia and Kenya. In the meantime, the funding of drilling activities in the EARS countries can potentially be aided through the Geothermal Risk Mitigation Facility (GRMF) or through other channels.

The GRMF was established by the African Union Commission on one side, and the German Federal Ministry for Economic Cooperation and Development (BMZ) and the EU-Africa Infrastructure Trust Fund via Kreditanstalt für Wiederaufbau (KfW) Entwicklungsbank on the other side, to fund geothermal development in East Africa (GRMF, 2014). The objective is to encourage public and private investors, as well as public-private partnerships to develop geothermal prospects for power generation in Eastern Africa by providing grants for two types of activity: surface exploration studies, and drilling and testing (GRMF, 2014). An example is a 5.6 million USD grant for initial drilling at the 1,000 MW Corbetti geothermal power project in Ethiopia (ThinkGeoEnergy, 2014).

Additional assistance to Africa comes from the Power Africa initiative, launched by the United States in 2013, to which 7 billion USD have been committed through 2018 in financial support and loan guarantees (USAID, 2014). The goal is to add more than 10,000 MW of clean, efficient electricity generation capacity through various collaborations and means, including technical assistance, grants, loans and risk mitigation insurance. Although the initiative is not specifically targeted towards geothermal development, Power Africa has already committed to an advisory role on the Corbetti project in Ethiopia.

In Latin America, the Japanese Trust Fund Consultancy financed a 0.9 million USD prefeasibility study for two selected sites in the Macizo Volcanico del Ruiz complex in Colombia, which was administered by the Inter-American Development Bank (IDB), and in 2011 the Global Environment Facility (GEF) provided a 2.7 million USD grant to Colombia, also through IDB, to promote investment in non-conventional renewable energy sources and lay the groundwork for a geothermal project at Macizo Volcanico del Ruiz (IDB, 2011).

Indonesia is tapping 400 million USD from Clean Technology Fund to develop approximately 800 MW of new geothermal generation supply at three sites, and to create risk sharing and finance facilities designed to accelerate investments in energy efficiency and renewable energy (CIF, 2014). Another example of direct support across borders in Asia is a pledge by the Government of New Zealand in 2012 to provide a 6.95 million USD technical assistance grant to support Pertamina Geothermal Energy's (PGE) 1000 MW geothermal investment program in Indonesia (World Bank, 2012).

These examples, which are by no means exhaustive, are indicative of the possibilities that governments and geothermal developers in the developing countries have in engaging multi-lateral and bi-lateral agencies, as well as foreign governments, for direct support of projects.

Regardless of the availability of funds, an able and committed workforce is needed for geothermal development to be realized. This has long been recognized internationally, as evident in the establishment of the International Institute for Geothermal Research at Pisa in 1970 (supported by the Italian Government and UNESCO), the Geothermal Training Course at Kyushu University in 1970 (supported by the Japan International Cooperation Agency), the United Nations University Geothermal Training Programme (UNU-GTP) in Reykjavik in 1978 (supported by the Icelandic Government), and the Geothermal Institute at the University of Auckland in 1978 (supported by the New Zealand Government and UNDP). Together these programmes have educated geothermal experts in the thousands, from a multitude of countries.

Recent examples of international support for geothermal capacity building include the education of geothermal experts from the EARS countries at UNU-GTP in Iceland, funded through the Geothermal Exploration Project, and the donation of 2.07 million USD to assist El Salvador in permanently establishing a regional geothermal training center for Latin America, based on two diploma courses already run at the University of El Salvador in 2010 and 2012. Of this amount, the Nordic Development Fund granted 1.25 million and the Inter-American Development Bank granted 0.82 million, with local commitments amounting to 0.77 million.

3.2 Loans

Development banks have been instrumental in the financing of many geothermal projects in Africa, Asia, and Latin-America. The World Bank's financing for geothermal development increased from 73 million USD in 2007 to 336 million USD in 2012, with projects underway in Indonesia, Kenya, Ethiopia, Turkey, Djibouti, and Nicaragua (ESMAP, 2013). The Inter-American Development Bank (IDB) took part in the financing of the 36 MW San Jacinto-Tizate geothermal project in Nicaragua, with a 40 million USD loan, and KfW Entwicklungsbank and its subsidiary Deutsche Investitions- und Entwicklungsgesellschaft (DEG) have contributed to the financing of power plants in Olkaria in Kenya (KfW, 2011).

Although these are but a few examples, they serve to provide an indication of financing support available from development banks for geothermal projects.

3.3 Insurance

As noted before, the risk inherent in drilling deep into the ground for resources that can only be inferred with indirect measurements prior to drilling and the high costs associated with those drilling activities present a large barrier to investment in geothermal projects. In order to increase certainty, governments can therefore support exploration and test drilling to prove geothermal resources, after which they can be passed on to developers for utilization. However, such an approach may not be viable in countries where State finances are restricted or where governments are unwilling to support geothermal exploration and resource quantification directly. Another approach to lower the barrier for investors to commit to geothermal projects is thus to alleviate their direct risk through insurance schemes.

There is considerable awareness of the need for risk mitigation insurance for geothermal drilling globally. In addition to direct grants for geothermal drilling already mentioned, which serve to reduce direct risk to investors, more conventional insurance schemes are warranted. In 2003, Munich Re group became the world's first insurer to develop a policy covering the costs of unsuccessful geothermal drilling projects (Munich Re, 2014). Since then, the group has insured various geothermal drilling projects in Germany and elsewhere, and entered into an agreement with the International Finance Corporation (IFC) to develop and pilot geothermal risk insurance in Turkey to reduce exposure to unproductive wells (IFC, 2014).

In 2012, Ngugi (2012) reported that the cost of wells in Kenya ranged between 3.5 and 6.5 million USD. Such significant costs for a single well suggest that drilling insurance can only be provided by entities with access to large funds, such as an international reinsurance group or international partnerships like the GGDP. The creation of such insurance schemes that are widely available to developers in various countries has the potential of significantly boosting the rate of geothermal development.

4. CONCLUSION

States and international development institutions have many tools for supporting the development of geothermal projects and these are used in myriad ways in many different countries. This support is of great importance to the growth of geothermal utilization world-wide. However, more can be done. Currently, a greater access to drilling risk mitigation schemes in a greater number of countries is needed. As suggested by the law of large numbers and the limited number of geothermal fields within any single country, the creation of such schemes should be launched and managed by international development institutions that have access to large funds and the possibility of pooling resources.

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