Lessons Learnt From Geothermal-Friendly Regulatory Frameworks in Iceland, Kenya, New Zealand, Philippines and The United States of America

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Keywords

Geothermal energy, policy, legislation, success factors, best practice, Iceland, Kenya, New Zealand, Philippines, USA

ABSTRACT

In some countries geothermal energy development advances quickly, while in others structural or policy challenges hinder the development of the indigenous geothermal resources. This article aims at highlighting some key features of successful national strategies. Best practice policies and other incentive schemes of five countries are presented (Iceland, Kenya, New Zealand, Philippines, USA). The outcome of the research is intended to be used to advise decision-makers in governments and international organizations. The findings concentrate on geothermal power generation; geothermal heating and cooling are not analyzed in this paper.

Key successful strategies identified include clear targets for geothermal in national legislation, resource use rights also for foreign investors, governmental incentive schemes such as cost sharing of exploration costs or grants, fair market prices which guarantee a secure rate of return, a clear institutional and regulatory set-up, i.e. a "one stop shop" with designated tasks and mandates, risk mitigation schemes, protection against currency risks and force majeure and strong strategic support from the government.

1. Introduction

Investors make decisions based on risks, predictions of their return, favorable and secure market conditions and the existence of an investor-friendly regulatory framework. Due to high up-front costs to prove the resources during the exploration and test drilling phases, investors, be it private or government, often prefer to invest in other operations where their rate of return is more secure. In order to stimulate investment which is in line with climate change mitigation efforts and in order to decrease the dependency on costly fossil fuels, some governments provide a geothermal-friendly investment climate and enabling regulatory framework conditions for geothermal energy development. Relevant enabling legislative and fiscal instruments include the following:

- Financial incentive schemes or government subsidies
- Risk mitigation schemes or insurance facilities
- Feed-in-tariffs
- Renewable energy policies giving priority to the development of certain resources
- Privileges regarding the connection to the grid network, transmission and distribution

The availability and application of these instruments in five countries are described below. Emphasis is placed on enabling instruments for hydrothermal resources for power generation. For some countries the enabling institutional landscape and support schemes from development partners (Kenya) are also presented.

2. Iceland

2.1 History and Current Status

Geothermal use in Iceland started around 1900 with first attempts to pipe hot water from natural hot springs to houses and greenhouses. In 1928 the first district heating system was installed in Reykjavik to residential houses and a swimming hall. The oil crisis in 1973 and 1979 greatly influenced Icelandic energy policies. Prior to the oil crisis already about 43% of the inhabitants of Iceland used geothermal space heating, 50% used oil and the remainder mainly electricity (Ketilsson, Olafsson, Steindottir and Johannesson, 2010). Increasing oil prices demonstrated the dependency of the island nation and led to policy changes. Geothermal and hydropower resources were investigated in detail, the necessary transmission pipelines built from the geothermal fields and heating utilities were established across the country. Today, over 90% of homes are heated with geothermal energy, the highest percentage in the world (Figure 1). Most of the district heating in Iceland comes from three main geothermal plants, producing over 800 MW_{th}. Other direct uses include heating of about 130 swimming pools, snow melting and de-icing of sidewalks and

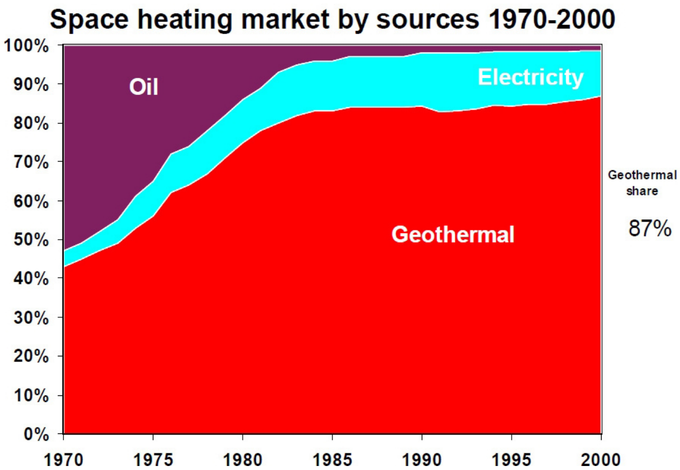

Figure 1. Energy sources for space heating 1970-2000 (Gunnlaugsson et al. 2001).

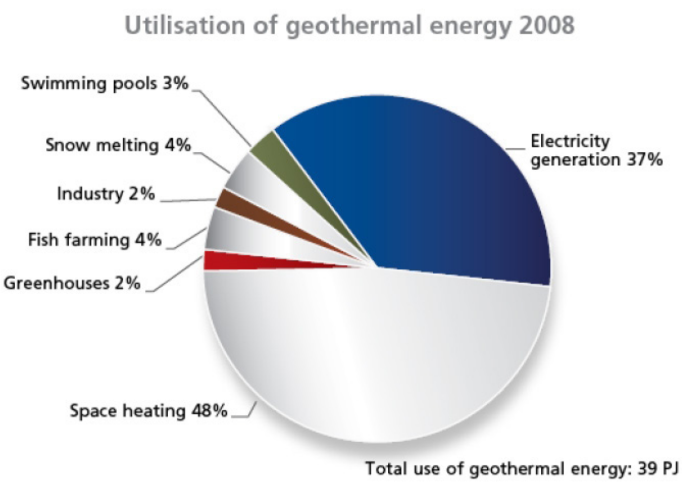

Figure 2. Geothermal use in 2008 (Ketilsson et al., 2010).

parking spaces (around 350,000 m^2), heating of greenhouses, fish farms and other industrial uses (see Figure 2). The first geothermal power plant with 3 MW_{el} started operation in 1969 in Námafjall.

2.2 Legal Framework

The Minister of Industry and Orkustofnun, the National Energy Authority can grant a prospecting license and ask for resource prospecting (Ketilsson et al., 2010). The ownership of resources cannot be sold by the state or municipalities. Only utilization rights tied to compliance criteria can be issued to a developer on public property. Compliance is officially monitored by Orkustofnun in line with the *Official Monitoring Act* and other acts. The monitoring scheme is rather complex, interdisciplinary, involves different public entities and is enforced by the Icelandic Government. Figure 3 shows the relevant monitoring fields. Monitoring objectives are to regulate the interaction of man and nature avoiding harm to the geosphere, air, sea and the entire environment. The *Strategic Environmental Assessment Act No 105/2006* regulates monitoring practices. Iceland also adopted Directive 2001/42/EC from the European Parliament and the Council. Resource monitoring, safety and management are legally defined in a concise manner. The legal framework is strictly set; compliance is regarded as crucial in sustaining a renewable energy society and a long lifespan of the resources.

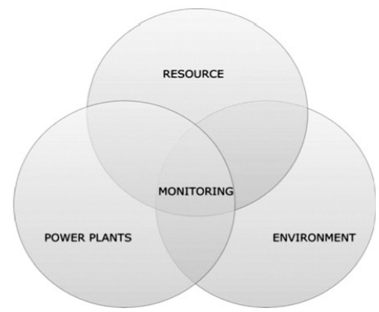

Figure 3. Relevant monitoring spheres for geothermal projects (Ketilsson et al., 2010).

The Electricity Act determines that power plants exceeding 1 MW installed capacity and smaller units which deliver power into the national transmission grid require a license. Smaller units are only asked to provide the National Energy Authority with the technical details of the plant.

Since 1999 the Icelandic Government develops the *Master Plan for Geothermal and Hydropower Development in Iceland* (Pálsson, 2012; Steingrimsson et al. 2006). Aims of the Master Plan are to rank power projects against their economic and preservation value, considering impacts, benefits, energy needs, man and nature. The country thus considers geothermal energy as a significant element in the functioning of their economic and social system and aims at developing it in a holistic manner. New energy strategies deriving from the 2009 Government Coalition platform include formulating (1) a new Planning and Building Act, and (2) a strategy how to fuel the transport sector.

Electricity producers compete on an open market. Combined Heat and Power plants are thus requested to keep separate accounts to avoid cross-subsidization of electricity.

2.3 Research and Training

Iceland stands out in a geothermal perspective due to its extensive engagement in research, training and advisory services. Research is ongoing through the Iceland Deep Drilling Project which aims at drilling 5 km wells to produce supercritical hydrothermal fluids at temperatures ranging from 450°C to ~600°C and at pressure of 23-26 MPa.

Iceland is also a partner in the International Partnership for Geothermal Technology (IPGT). IPGT as international collaboration of scientists, industry leaders, governmental representatives and geothermal experts uses synergies and geothermal expertise from Australia, Iceland, New Zealand, Switzerland and the US.

Also, the University of the United Nations has a branch in Iceland, which implements the Geothermal Training Program (UNU-GTP). UNU-GTP undertakes significant geothermal training for the whole world. Other overseas extension and advisory activities are conducted by the Iceland GeoSurvey ISOR who acts as consultant offering expertise in geothermal energy development.

In conclusion, geothermal energy has been a stable and reliable provider of electricity and heat for the island nation over a long time. It facilitates the operation of the power-intensive aluminum industry; discussion for green electricity export to the UK and Scotland are ongoing. The legal framework is complex, but clear definitions and regulations deem crucial in ensuring the sustainability of the resource and in complying with social and environmental standards. Geothermal energy yields excellent economical results for the country, is reliable, makes the country independent of fossil fuels and does not require much subsidizing due to cost competitiveness and the favorable geological setting.

3. Kenya

The Government of Kenya has commenced the process of developing 5,000 MW_{el} in line with the Kenya Vision 2030. The geothermal road map includes the installation of 250 MW_{el} annually, drilling 20 wells annually and operating 12 rigs. Up to now, the Government of Kenya has already contributed US$ 399 million into geothermal projects while the donor community has committed over US$ 1.343 billion (Ngugi, 2012). A ranking of the geothermal fields and clear development priorities are paving the path which initially focused on the Olkaria field and now extends to the Menengai complex, the Bogoria-Silali field and others following (see Figure 4).

Figure 4. Geothermal fields in Kenya (Ndetei, 2011).

3.1 *Institutional Set-Up*

The institutional set-up in Kenya was restructured in 2009 (see Figure 5). Main geothermal stakeholders include:

(1) the Ministry of Energy (MoE)

(2) the Geothermal Development Company Limited (GDC), owned by the government as resource developer and steam provider

(3) the Kenya Electricity Generating Company Limited (KenGen) and Independent Power Producers (IPP) as plant operators

(4) the Kenya Electricity Transmission Co. Ltd. (KETRACO) and Kenya Power and Lighting Company (KPLC) as transmitter, distributor and retailer

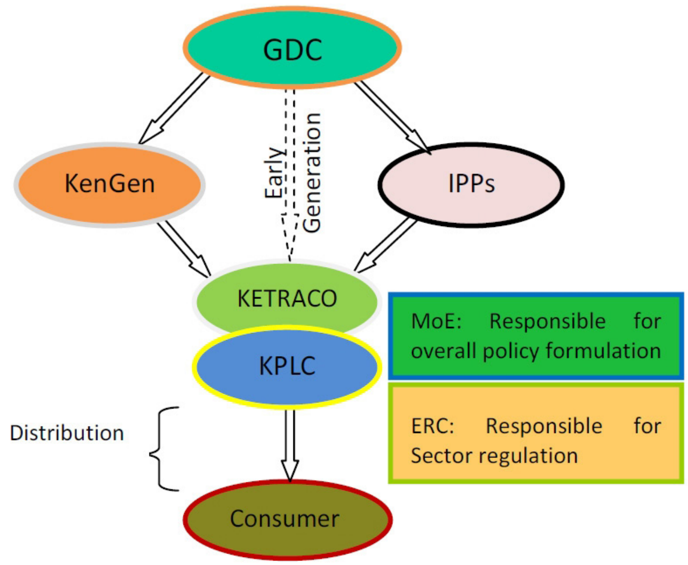

Figure 5. Key entities in the energy sector in Kenya (Ngugi, 2012).

The Ministry of Energy offers key responsibility over the entire value chain and coordinates the development to match generation to transmission and distribution. Investment and business transactions are legally bound by contractual agreements.

3.2 *Regulatory Framework, Government Incentives, Development Partners*

Foreign investors can freely repatriate their income to other countries and can hold foreign currency. The government created special institutions to promote foreign investment in Kenya and strives to keep a stable political situation.

The Kenya experience shows that government financing in the resource exploration and appraisal phase is crucial. In this early risky stage private sector is usually unwilling to invest and thereby bearing the high risk exposure. According to Ngugi (2012) green field development requires about 100 million US$ in Kenya to explore and appraise, including 10 exploration and appraisal wells, feasibility study, access roads and a drilling water reticulation system. Multilateral and bilateral financing partners, such as the World Bank, the German Development Bank KfW, the French Development Bank or the African Development Bank are crucial supporters at this stage providing loans, grants and risk mitigation facilities. The KfW-EU funded Geothermal Risk Mitigation Facility for East Africa recently launched holds 50 million Euros and provides grants for surface studies and the drilling of exploration wells (EU-Africa Infrastructure Trust Fund, 2012).

This incentive aims to encourage private and public developers to exploit geothermal resources in East Africa.

Proving the bankability of the project is critical in finding further development funds. In Kenya private investors obtain a reasonable return, as calculated by the government. Steam price is expected to be about 3.5 US cents per kWh while the total generation cost ranges between 7-10 US cents per kWh (Ngugi, 2012). A fixed feed-in-tariff of up to 8.5 US cents per kWh for 20 years for the first 500 MW_{el} installed capacity is guaranteed by the government in its "Feed-in-Tariffs policy on wind, biomass, small-hydro, geothermal, biogas and solar resource generated electricity" of Jan. 2010.

Also, a sound legal knowledge base of the staff is crucial. In Kenya, as in other countries, the regulatory framework is complex and any projects are subject to environmental and other regulations. Regulations of importance for geothermal energy development include the Geothermal Resources Act of 1982, the Lakes and Rivers Act (Cap. 409), the Electric Act of 1997, Environmental Impact Assessment and Audit Regulations (legal notice No. 121 of 2003) and other regulations. Mwangi-Gachau (2010) and Ndetei (2011) describe the legal requirements in great detail. The Environmental Management and Co-ordination Act No 8 of 1999 for example requires that set standards in line with the Kenya Bureau of Standards are kept. The act also determines that prior to any development all required licenses must be obtained and that an environmental impact assessment is required prior to any development.

Legislative obligations not only include national legislation, but also operational guidelines of donors, i.e. the World Bank Safeguard Policies or international conventions and treaties like the Convention on Biological Diversity or the United Nations Framework Convention on Climate Change (UNFCCC).

A convinced government has all powers to determine developments. The *Least Cost Power Development Plan (2008-2028)* prepared by the Government of Kenya indicates that geothermal plants have the lowest unit cost, provide base load power and are thus recommended for additional expansion (Ndetei, 2011).

4. New Zealand

New Zealand's geothermal power plants with an installed capacity of 628 MW_{el} generate about 10% of the country's electricity (Harvey, White, Lawless and Dunstall, 2010). The New Zealand Energy Strategy to 2050 and the New Zealand Energy Efficiency and Conservation Strategy published in 2007 set out a coordinated energy strategy. Geothermal energy is seen as a significant resource to attain the 90% renewable target in electricity generation by 2025.

4.1 Legislation

Due to legislative changes in the late 1980s and the regional concentration of geothermal resources in the country, 80% of New Zealand's geothermal resources are managed by the Waikato Regional Council (Environment Waikato). The *Resources Management Act (RMA) 1991* with its planning instruments are since then applied for managing and developing geothermal resources (Dickie and Luketina, 2005). The regional councils strive to achieve an integrated management of natural and physical resources through sustainable use and by respecting the beliefs of the Maori. Significant geothermal resources are located on Maori land, communal lands or private land. Access policy thus also needs attention. Malafeh and Sharp (2011) conclude that fragmented land ownership systems with multiple access to the resource may lead to faster depletion of the resource. Traditional Maori society allows the use of geothermal resources as long as their cultural values are respected and the resource persists for present and future generations.

The RMA manages air, water, soil, land, geothermal, some minerals and coastal resources. Geothermal resources herein are listed, ranked and classified into five types (Dickie and Luketina, 2005):

(1) Development

(2) Limited development

(3) Research

(4) Protected

(5) Small

The RMA provides a comprehensive suite of policy, planning and regulatory instruments. Waikato Environment values geothermal and is very aware of its special characteristics such as efficiency, effects on other land uses, sustainable production, biodiversity, high risk development, etc.

In the region of the Bay of Plenty where one of the largest reservoirs, the Rotorua field is located, a special regional plan sets clear targets, application procedures for geothermal projects and manages the sustainable use of the geothermal reservoir and tourism sites (Luketina, 2000).

Strict enforcement procedures exist also. Waikato Environment set in place a strict Code of Practice with penalty fees and clear procedures to involve the public, set procedures for application submissions and processing.

4.2 Research Incentives

The Ministry of Science and Innovation invests NZ$ 6.5 million (USD 4.9 million) in geothermal innovation and technology research. Also, the Royal Society of New Zealand provides substantial funding, i.e. into the project "The Underground Eye" of NZ$ 8.84 million (USD 6.7 million) over five years.

In 2002, the New Zealand Government signed the Kyoto Protocol and recognizes the protocol obligations through the Climate Change Response Act 2002. Carbon credits can be tendered for and several geothermal projects have benefitted from this. In the 1980s the discovery of the Maui natural gas field halted the initial geothermal exploration and research initiatives. Maui is the largest gas, natural gas condensate and oil field in New Zealand, producing nearly three-quarters of the country's hydrocarbons. Now, as the resources at Maui are depleting, interest in geothermal exploration started again.

5. Philippines

The Philippines are the second largest geothermal electricity generator in the world with an installed capacity of 1,904 MW_{el} in 2010. Due to the favorable geological setting in the western flank of the Circum-Pacific Ring of Fire, the extraction of steam from geothermal resources is fairly cheap compared to generating steam using natural gas, coal or other fossil fuels. Large producers of geothermal energy in the world operate in the Philippines and share their expertise with other geothermal experts. The development of geothermal in the country started with the oil crisis in the early 1970s, exposing the country's vulnerability to imported fossil fuel. The government soon after created the *Philippine National Oil Company - Energy Development Corporation (PNOC-EDC)* which was tasked to develop the indigenous geothermal resources. First projects were initiated on Luzon island by Philippine Geothermal Incorporated (now Chevron), to be followed by other developers (Catigtig, 2008).

Table 1. Policies stimulating geothermal development in the Philippines (Catigtig, 2008).

Year	Legislation	Enactment
1973	Presidential Decree 334	Creation of the Philippine National Oil Company (PNOC)
1975	Presidential Proclamation 1112	Established the Geothermal Reservation in Tongonan, Leyte
1976	Presidential Decree 927	Created the Energy Development Corporation (EDC) under PNOC
1978	Presidential Decree 1442	Enacted the Philippine Geothermal Service Contract Law
1987	Executive Order 215	Allowed private sector to finance, build, and operate power plants
1992	Presidential Proclamation 853	Established the Geothermal Reservation in Mt. Apo, Cotabato
1990	Republic Act 6957	Enacted the Build Operate Transfer Law
2001	Republic Act 9136	Enacted the Electric Power Industry Reform Act - Privatization of the National Power Corporation

With the enactment of the legislation as depicted in Table 1 the Department of Energy reflects their initiative to support and enable geothermal development. Further decrees enable the private sector to enter the market. The monopoly of the National Power Corporation was thus removed. Now, Build-Operate-Transfer (BOT) are the preferred contractual arrangement where private contractors and foreign investors finance, construct, operate and maintain the power plant for a number of years. After the agreed cooperation period the power plant is handed over to EDC.

5.1 Legislation

The *Philippine Geothermal Service Contract Law (Presidential Decree 1442)* provides significant incentives to geothermal developers. In Section 4 the decree regulates the following:

a) Exemption from payment of tariff duties and compensating tax on the importation of machinery and equipment, spare parts and all materials required for geothermal operations

b) Entry of foreign technical and specialized personnel who may exercise their profession solely for the operations of the contractor

c) Repatriation of capital investment and remittance of earnings derived from its service contract operations

(Chan Robles Virtual Law Library - Philippine Supreme Court Decisions, 2012)

The *Renewable Energy Act of 2008 (R.A. 9513)* established the necessary infrastructure and mechanisms to carry out the government's thrust to promote the development, utilization and commercialization of renewable energy sources. The act promotes the purchase, grid connection and transmission of electricity generated from renewable energy sources. *Renewable Portfolio Standards* exist which place an obligation on the electricity supply company to distribute a percentage of their electricity from renewable energy sources. In addition, incentives such as exemption from various taxes and duties to renewable energy developers are provided through the act to make investments more attractive. The act also defines geothermal as mineral resource.

Market support schemes also include a presidential order that directs local government units in certain areas near or adjacent to geothermal power plants to develop economic zones that will draw power from these plants.

Technical and R&D support is provided by the government through the identification of potential sites of geothermal energy resources where investors may undertake pre-development or exploration activities. The government also assists private entities who have identified frontier areas by providing technical assistance in further determining if these areas warrant the establishment of a power plant.

5.2 Financial Incentives

Financial support schemes include:

- Renewable Energy Trust Fund (RETF) administered by the Department of Energy aiming at financing research, development, demonstration of productive RE use
- The Project Preparation Fund (PPF) managed by the Land Bank of the Philippines
- Loan Guarantee Fund (LGF) - LGU Guarantee Corporation, and Banco de Oro – Universal Bank will act as the Program Manager and Escrow Agent
- New and Renewable Energy Financing Program (NREFP) managed by the Development Bank of the Philippines

Fiscal incentives include (Penarroyo, 2010):

- Income Tax Holiday (ITH) for 7 years
- Duty-Free importation of RE machinery, equipment and materials
- Special realty tax rates on equipment and machinery
- Net Operating Loss Carry-Over (NOLCO)
- Corporate tax rate of 10% on net taxable income after 7 years of ITH
- Accelerated depreciation
- 0% VAT rate
- Tax exemption of carbon credits
- Tax credit on domestic capital equipment and services - VAT and custom duties

The grid system operators are obliged to purchase, connect to the grid and transmit geothermal energy as a priority.

Regarding the institutional landscape the *Renewable Energy Management Bureau (REMB)* was created and incorporates the geothermal division (Penarroyo, 2010). Functions of the REMB are (among others) to develop, formulate and implement plans and policies, to develop a centralized and unified information base on renewable energy resources, to promote and conduct technical research on renewable energy sources.

The training approach applied in the Philippines involved practical on-the-job training in the field together with foreign experts as well as sending staff overseas to respected geothermal training institutes such as in Iceland or in New Zealand (Catigtig, 2008). This comprehensive approach led to a very good technical expertise on geothermal energy in the Philippines.

6. United States of America

The US are the largest geothermal electricity generator worldwide with an installed capacity of 3,093 MW_{el} in 2010. The US has a vibrant industry buoyed by an improving business environment that benefits from financial incentives. In addition to its domestic program, the US is a member country in the International Partnership for Geothermal Technology (IPGT).

6.1 Legislation

The history of geothermal development and success factors were described extensively by Lund and Bloomquist (2012), Rybach (2010), Bloomquist (2006, 2008) and others. Only some legislative highlights are listed here. Initially, two acts set the framework for geothermal development:

(1) the California Geothermal Resources Act of 1967

(2) the Federal Geothermal Steam Act of 1970

In the beginning, the resource was clearly defined and provided the foundation for subsequent legislation on permitting, environmental ownership, financial incentives and risk reduction. Definitions of geothermal (as water, mineral, sui generis, heat, steam) vary from state to state in the US. The definition is seen as a crucial step in the process.

The Federal Geothermal Steam Act of 1970 was modified in subsequent years intending to reduce risk, provide fiscal incentives and accelerate the leasing of land to foster geothermal development. Other federal incentives included the Investment Tax Credits (ITC) enacted in 1978, the Public Utilities Regulatory Act of 1979 (PURPA); and the Federal Production Tax Credit (PTC) first applying to geothermal in 2004.

The *PURPA* needs to be highlighted as it allowed for the first time for non-utility companies to generate electricity. Hereby, a private power industry could evolve. Utilities were required to purchase electricity from the private sector and provide transmission and backup electricity service.

The Energy Security Act of 1978 provides for deduction of intangible drilling costs and allowed for percentage reservoir depletion allowances.

6.2 Federal Risk Reduction Programs and Fiscal Incentives

Fiscal incentives included the *Geothermal Loan Guarantee Program (GLGP)* which enabled loan guarantees to be granted for up to 75% of the project costs with the federal government guaranteeing up to 100% of the amount borrowed. The GLGP aimed at enhancing competition and encourage new entrants into geothermal markets.

In 1980 the *User Coupled Confirmation Drilling Program* was initiated by the US Department of Energy aiming at substantially reducing risk through cost-sharing with industry partners in the exploration phase of confirming hydrothermal reservoirs. The program included siting drill holes, drilling, flow testing and reservoir engineering. An extra benefit included that significant engineering and geoscientific expertise was gathered and could be used for future exploration, reservoir confirmation and plant development.

Several US states adopted *Renewable Portfolio Standards*. These ensure that a minimum amount of renewable energy is included in the electricity retail of utilities.

The *Production Tax Credit (PTC)* was applied to geothermal from 2004 onwards and included 1.8 USD cents per kWh for a 5-year period as initial tax credit. Recently, the tax credit was increased to 2.0 USD cents/kWh. This fiscal support scheme is quite detrimental for triggering geothermal projects.

Some federal states also enacted tax incentives programs. These programs took the form of business tax credits, residential tax credits, property tax exemptions, sales tax exemptions and exemptions on public utility taxes.

The *Program Research Development Announcement (PRDA)* was initiated in 1976 and provided funds for feasibility studies, supported technologies for industrial processes and moderate to low temperature heat (i.e. agriculture, space, water and soil heating for greenhouses, grain drying, irrigation pumping, district heating and cooling for business complexes and public buildings). Grants were limited to USD 100,000 - 125,000 upon the reception of project proposals.

Successful projects were also achieved through the *Program Opportunity Notice Program (PON)*, which provided incentives for geothermal direct-use projects and combined electrical/direct applications. With the funds provided five schools, one hospital, one prison, eight district heating projects and four agribusiness projects were financially supported (Lund and Bloomquist, 2012).

Since 2009 almost US$ 400 million have been made available for initiating geothermal technical projects through the *American Recovery and Reinvestment Act (ARRA)*. Emphasis is placed on innovative exploration and drilling projects, Enhanced Geothermal System demonstration projects, geoscientific data acquisition and ground source heat pumps.

The program *GeoPowering the West (GPW)* brought various US academic institutions, the public and industry associations together aiming at extending geothermal electric power facilities to eight federal states, educating the public and facilitating a dialogue between various stakeholders.

A remarkable technical assistance approach was the US DOE's *Technical Assistance Grant Program*. New geothermal developers could apply for technical advisory of a consultant/ research institute for up to 100 hours. Assistance sectors included resource assessment or feasibility studies. Later on, the assistance was limited to eight hours (Lund and Bloomquist, 2012).

The geothermal industry in the United States currently enjoys an unprecedented level of support from Congress and President Obama's Administration. The *American Reinvestment and Recov-*

ery Act of 2009 allocated USD 400 million to the Department of Energy's Geothermal Technologies Program.

Analyzing the support programs it can be concluded that the US undertook substantial efforts in meeting the needs of emerging technologies. Geothermal has been the focus of numerous policy initiatives. Instruments included loans, grants, cost-sharing schemes, risk mitigation schemes and technical assistance.

7. Conclusion

The enabling framework analysis shows that national governments are decisive in geothermal development. Governments set the legal and financial framework conditions for the electricity market, private sector involvement, research, politics and human capacity development in geothermal.

Financial and fiscal incentives as provided in the US and Philippines set the conditions for a private power industry and opened the market to foreign investors.

Feed-in-tariffs as applied in Kenya for geothermal create a stable market and secure the rate of return for the private sector. The feed-in-tariff system set up in Germany initially in the 1990s was a showcase globally and adapted to over 60 countries (REN21, 2011).

Renewable Portfolio Standards as enacted in the Philippines, the Least Cost Power Development Plan of Kenya, production tax credits and other tax incentive programs (business tax credits, sales tax exemptions, etc.) as applied in the US trigger investment.

Risk mitigation schemes or insurances as offered in the US through the User Coupled Confirmation Drilling Program or by the EU-German funded Geothermal Risk Mitigation Facility in East Africa provide attractive incentives in opening new geothermal markets under higher risk conditions.

Planning, monitoring and priority setting instruments as the Master Plan for Geothermal and Hydropower Development in Iceland reflect that monitoring procedures, priority settings against other land uses, clear Codes of Practice for field development and management, involving environmental issues, public concerns, tourism, sustainable production, enforcement are crucial. Also, the Resources Management Act of 1991 of New Zealand requires emphasis here, adding social issues such as respecting ancestral lands and rights of ethnic minorities.

Roadmaps and visions are effective planning and PR tools reflecting the political will and initiative of governments. The Kenya Vision 2030 liased with political will and motivated staff in Kenya stimulates market development and convinces bi- and multilateral donors to support the country.

Clear institutional set-ups as depicted for Kenya enable private investors to orient themselves and establish contact with the entities in charge.

Research and funding innovative research programs can significantly shape geothermal technology advancement. The Deep Drilling Project funded by the Icelandic government and other demonstration project can lead to major breakthroughs and meaningful geothermal expansion.

Training of staff and a capable workforce requires time, but is one of the success factors to geothermal development. Overseas training and knowledge exchange programs were a focus in all presented countries.

The behavior of private investors is unpredictable. Also, historic events such as the discovery of natural gas fields can determine geothermal projects. However, the above five case scenarios show that enabling regulatory frameworks, financial incentives, support to research programs and human capacity building play significant roles in geothermal energy development.

The outcome of the analysis is used as best practices in guiding, conceptualizing and improving the enabling framework settings for geothermal energy in other countries.

References

Bloomquist, Gordon R., Patel, Babul and Zimmermann, Charles F. 2011. *Developing geothermal policy.* Proceedings of the Kenya Geothermal Conference, Nairobi, Kenya, 21-22 November 2011.

Bloomquist, R. Gordon 2006. *The federal process - Geothermal resources in the United States.* Washington State University, Olymbia, USA.

Catigtig, Danilo C. 2008. *Geothermal energy development in the Philippines with the Energy Development Corporation embarking into power generation*. Proceedings of the 30th Anniversary Workshop, Reykjavik, Iceland, 26-27 Aug. 2008.

Chan Robles Virtual Law Library - Philippine Supreme Court Decisions 2012. *Presidential Decree No. 1442: An Act to promote the exploration and development of geothermal resources*. Website:http://www.chanrobles.com/presidentialdecrees/presidentialdecreeno1442.html, sited on 1 May 2012.

Dickie, Blair N. and Luketina, Katherine M., 2005. *Sustainable management of geothermal resources in the Waikato region, New Zealand*. Proceedings World Geothermal Congress 2005, Antalya, Turkey, 24-29 April 2005.

EU-Africa Infrastructure Trust Fund 2012. *Geothermal Risk Mitigation Facility*. Website: http://www.eu-africa-infrastructure-tf.net/activities/grants/geothermal-risk-mitigation-facility.htm, sited on 24.05.2012.

Gunnlaugsson, Einar, Ragnarsson, Arni and Stefánsson, Valgarður 2001. *Country update 2001 - Geothermal energy in Iceland*. International Symposium in Izmir, Turkey, 4-5-October 2001.

Harvey, Colin C., White, Brian R., Lawless, James V. and Dunstall, Michael G. *2005-2010 New Zealand country update.* Proceedings World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010.

Ketilsson, Jonas, Olafsson, Larus, Steinsdottir, Gudlin and Johannesson, Gudni A. 2010. *Legal framework and national policy for geothermal development in Iceland*. Proceedings World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010.

Luketina, Katherine M. 2000. *New Zealand geothermal resource management - a regulatory perspective*. Proceedings World Geothermal Congress 2000, Kyushu, Tohoku, Japan, 28 May - 10 June 2000.

Lund, John and Bloomquist, R. Gordon 2012. *Development of geothermal policy in the United States - What works and what doesn't work.* Proceedings, 37th Workshop on Geothermal Reservoir Engineering, Stanford, USA, 30 Jan.-1 Feb. 2012.

Ministry of Energy of Kenya, 2010. *Feed-in-Tariffs policy on wind, biomass, small-hydro, geothermal, biogas and solar resource generated electricity*. Nairobi, Kenya, Jan. 2010.

Ngugi, Paul, 2012. *Financing the Kenya geothermal vision*. Presented at "Short course on geothermal development and geothermal wells", El Salvador, 11-17 March 2012.

Malafeh, Sam and Sharp, Basil. *Unitisation of geothermal resources: Economics and Policy*. Proceedings of the New Zealand Geothermal Workshop 2011, 21-23 November 2011, Auckland, New Zealand.

Ministry of Economic Development of New Zealand 2011. *Developing our Energy Potential and the New Zealand Energy Efficiency and Conservation Strategy 2011–2016*. Website: http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/energy-strategies/nz-energy-strategy-lr.pdf, sited on 24.05.2012.

Mwangi-Gachau, Elizabeth 2010. *Legal requirements for geothermal development in Kenya.* Short course, Naivasha, Kenya, 29 Oct.-19 Nov. 2010.

Ndetei, Cornelius 2011. *Regulatory frameworks and their implications in geothermal development projects - the case of Kenya*. Proceedings of the Kenya Geothermal Conference, Nairobi, Kenya, 21-22 November 2011.

Pálsson, Bjarni 2012. *Master Plan for Geothermal and Hydropower Development in Iceland*. Proceedings of the 2012 Geothermal Workshop in Fukuoka "Toward new geothermal development strategies in Japan and in the world". 26 March 2012, Fukuoka, Japan.

Penarroyo, Fernando 2010. *Renewable Energy Act of 2008: Legal and Fiscal Implications to Philippine Geothermal Exploration and Development*. Proceedings World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010.

REN21, 2011. *Renewables 2011 - Global Status Report*. Paris, REN21 Secretariat. Website: http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR2011.pdf, sited on 18.04.2012.

Steingrímsson, Benedikt, Sveinbjörn, Björnsson and Hákon, Aðalsteinsson, 2006. *Master Plan for Geothermal and Hydropower Development in Iceland.* Proceedings Workshop for Decision Makers on Geothermal Projects in Central America, El Salvador, 26 Nov. - 2 Dec. 2006.

Wallonic Export and Foreign Investment Agency 2012. *Geothermal Energy*. Website: http://www.awex.be/fr-BE/Infos%20march%C3%A9s%20et%20secteurs/Infossecteurs/Documents/ASIEPAC/Renewable%20Energy%20-%20Geothermal.pdf, sited on 18.04.2012.