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Legal and Regulatory Environment Favorable for Geothermal Development Investors

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ABSTRACT

It can be expected that investors will nowadays turn to objects that can provide -due to their reliance on natural laws- more investment safety than volatile financial products. In this change they look for attractive conditions. Favorable regulatory environment in geothermal power development largely contributes to such conditions, by legislative instruments like feed-in tariffs, geologic risk coverage, and risk insurance systems. In addition, a whole suite of additional instruments exists like governmental start-up support. These are described and examples are given. Favorable legislative schemes have already triggered substantial geothermal growth, nevertheless there is still lots of legal development ongoing. As a medium term goal a harmonization of legislation, quite different by nature in different countries, should be attempted.

1. INTRODUCTION

Investors are looking for maximum predictability in future performance when making investment decisions. They are especially interested in the safety of return on investment. Given the dislocated and unpredictable markets, investor interest is moving away from complicated, intransparent financial products such as complex credit derivatives, hedge funds, or infrastructure certificates. Rather, they will want to invest in products that are governed by known and proven natural forces. At the same time, investing in megatrends such as environmental protection and the mitigation of climate change can bring additional benefits. Investing in renewable energy development can provide interesting options in this context.

While some renewables harvested at the surface - like hydropower and wind (to some extent even solar) energy - can themselves be influenced by climatic changes, the geothermal option is independent of surface changes: it relies solely on resources in the earth's interior.

Specific to geothermal energy development is the need of high up-front investment for exploration and test drilling. In addition, geologic risk exists at sites with only partially known subsurface conditions: there the yield of the targeted resource can remain below expectations. Investors, therefore, require favorable conditions for their financial participation in geothermal development.

There are several legislative instrument that provide a favourable environment and even incentives for investors to get involved in geothermal development:

- Feed-in tariffs
- Geologic risk coverage
- Risk insurance schemes
- Additional measures like portfolio standards, tax credits, governmental support.

These instruments are described and various examples are given below. The emphasis is on hydrothermal resources development for power generation or direct uses like district heating, as shallow resources (usually utilized by heat pumps and currently accounting for the majority of geothermal development) have practically no risk components.

2. FEED-IN TARIFFS

Feed-in tariffs (FIT) are guaranteed take-over prices the producers of electricity from renewable sources obtain from utilities. Such tariffs have been introduced now in many countries, especially in Europe. Although the prices vary from country to country significantly, and the highest tariffs are usually assigned to solar photovoltaic electricity, the FITs greatly help renewable energy development, also of geothermal.

Table 1 assembles the feed-in tariffs in a number of countries. Usually the tariffs depend on power plant size and also a time frame is given within which the investors can rely on the investment safety. Table 2 assembles more details about the German and Swiss FIT systems.

Table 1: Feed-in tariffs for geothermal electricity in some European countries (for Germany and Switzerland see Table 2). Source: Leipziger Institut für Energie, www.ie-leipzig.de.

Country	Feed-in tariff for geothermal electricity (€ct/kWh)
Austria	7.0
Belgium	2.5
Czech Republic	15.56
Estonia	5.10
France	7.62 (overseas: 7.93)
Greece	7.31
Slovakia	9.04
Slovenia	5.85 + 2.52
Spain	6.49 + 2.94

The German FIT system is based on the new EEG Law ("Erneuerbarer Energie Gesetz"), issued on 1 Janaury 2009. The law defines the purpose, the realm of application, the takeover and grid transport obligations of utilities, the modalities of tariff payment including the tariff development with time. For geothermal electricity the tariffs start to decrease from 1st January 2010 onwards, annually by 1%. Currently a “strat-up” bonus of 4 €cent/kWh is provided until 1st January 2016, a bonus addition for “petrothermal” systems (operating in non-sedimentary, non-hydrothermal environment like granites) of 4 €cent and for heat usage (e.g. in district heating systems) of 3 €cent. In Germany the introduction of the FIT system has triggered large-scale geothermal development: numerous, mainly hydrothermal projects (producing hot water from deep aquifers) have been initiated countrywide (34 projects in November 2008), mostly for communal co-generation (=electricity and district heating). The data base of the website http://www.geotis.de keeps track of the developments.

In Switzerland a similar system has been introduced (Rybach, 2008). The cost-covering remuneration for feeding electricity from renewable energy sources into the grid is based on the new Federal Electricity Supply Act (entered into force on 1 January 2008). The tariffs are specified in the Federal Electricity Supply Ordinance (entered into force on 1 April 2008). The Ordinance defines the geothermal facilities (e.g. no combination with fossil generation), the tariffs (cf. Table 2), the duration, the application procedure, and requests transparency of operational data towards the Swiss Federal Office of Energy (SFOE). The Swiss FIT is constant until year 2017; from 2018 onwards it decreases by 0.5%/year. An annual ceiling exists for the total amount of payments, currently at 330 MCHF (about 310 MUS$); CHF 100 MCHF (about 95 MUS$) are potentially available for geothermal projects. There is already some experience with the FIT system: whereas a large number of applications for solar, wind and biomass projects have been received and granted the FIT system impact on geothermal development in Switzerland is not yet visible (Table 3).

Ususally the FIT systems are independent of the time of feed-in. An interesting exception exists in Hungary: here the tariff is higher at peak demand times (usually around mid-day). Obviously solar and geothermal sources benefit from such schemes.

3. GEOLOGIC RISK COVERAGE

For any kind of geothermal energy utilization the energy (= internal heat of the earth) must be extracted and transported to the earth’s surface. This is realized by production wells, i.e. boreholes must be drilled. A so-called “geologic risk” exists especially at sites with only partially known subsurface conditions: the yield of the targeted geothermal resource can remain there below expectations.

Table 2: German and Swiss feed-in tariffs for electricity from geothermal power plants. Data for Germany from EWD (2009).

Germany		Switzerland	
Nominal capacity (MWe)	**€cent/kWh)**	**Nominal capacity (MWe)**	**CHF*/kWh)**
0 - 10	16	≤ 5	0.30
		≤ 10	0.27
>10	10.5	≤ 20	0.21
		> 20	0.17

*) 1 CHF ≈ 0.90 US$ and ≈ 0.68 € (as of 6 January 2009).

In several technologic solutions the geothermal systems work with “loops”: besides production wells also reinjection boreholes are needed. The risk with the latter is insufficient fluid uptake. Risk coverage schemes aim at the reimbursement of a certain percentage of the investments. As examples, governmental risk coverage systems form France and Switzerland are given below.

3.1 French System (Details from Boissier, 2008)

In France the governmetal risk coverage system exists since 1981. The “Short-term Risk Guarantee” secured that a project manager is reimbursed for all or part of the investments made in the event of total or partial failure of the drilling operations. The “Long-term Risk Guarantee” allowed project managers to be covered during a 25 years exploitation phase against the risk of having the geothermal resource decrease or disappear, and against damages that may occur to their installations. So far about 10 M€ have been spent, exclusively for space heating projects using the “doublet” system with one production and one reinjection well.

Table 3: Swiss experience with FITs: Feed-in tariff applications status as of 31 July 2008 (number of submitted and accepted applications). Source: Kaufmann (2008).

Source	**Submitted**		**Accepted**		**Applied capacity**		**Approved**
		%		**%**	**kW**	**%**	**kW**
Solar PV	4’036	82	1’117	29	89’042	8	21’420
Wind	343	7	343	100	656’299	56	656’299
Hydro **(**<10MW**)**	347	7	347	100	238’264	20	238’264
Biomass	187	4	182	97	192’821	16	141’821
Geothermal	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	4’913	100	2’049	42	1’176’426	100	1’057’804

In 2007 a new subsidy scheme for the development of renewable energies was set up for the 2008-2013 period by ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie), including more subsidies for geothermal energy than the previous scheme. In this new system, feasibility studies for geothermal projects can be supported up to 50% of the cost of the study. Investments can be supported up to 40%, for demonstrating operations, i.e. operations with new concepts or with technologies not well-known, as for example operations with energy piles or underground thermal energy storage operations coupling solar heat and geothermal borehole heat exchangers. Support of up to 30 % for operations not disseminated widely enough but which can be easily replicated, i.e. exemplary operations like greenhouse heating or swimming pool heating with geothermal energy, plants with deep aquifers not often exploited. Support of up to 20% is available for the dissemination, e.g. geothermal district heating plant exploiting well-known deep aquifers like in Paris Basin, or shallow aquifers exploited with heat pumps for large buildings heating and cooling.

A special risk coverage system exists for large groundwater heat pump systems (>30 kW): it is called AQUAPAC and covers drilling risk (e.g. reinjection failure) and resource deterioration. Coverage duration is max. 10 years, max. covered amount: 115,000 € (Bézèlgues-Courtade, 2008).

3.2 Swiss System (Details from Rybach, 2008)

The first governmental risk guarantee system existed 1987-1997 for geothermal drillings with a total sum of 10 million CHF in order to stimulate direct use development. The risk guarantee system was established by the Parliament in 1986 and implemented by the Federal Government in 1987. The system intended to encourage the involvement of public institutions and private enterprises in geothermal direct use (mainly space heating). 15 MCHF were allocated to the risk guarantee fund and established in 1987 for 10 years. The risk guarantee fund was applicable to development drillings with depths >400m. The coverage extended to 50% of drilling and testing costs (also of reinjection); in specific cases up to 80%. The risk guarantee covered the accrued costs in case of insufficient thermal power. No coverage was provided for permitting, insurances, unforeseen and capital costs; in case of success no contributions have been paid.

The first risk coverage program was applied, in the years 1987 – 1997, to 13 projects in various parts of Switzerland, in contrasting geologic environments. From 1991 on the SFOE provided, in addition to the risk coverage, also a subsidy for special measures. The program yielded mixed results: 5 success, one partial success and 7 failure cases (Figure 1). The total sum paid for risk guarantee was 8 MCHF, for subsidy 3.4 MCHF. A more detailed description and evaluation of the first risk coverage system can be found in Rybach (2005).

In 2008 an new Governmental risk coverage system has been introduced. The new Swiss Electricity Supply Decree „Stromversorgungsverordnung, SVV 743.71“, 14 March 2008 stipulates that geothermal power projects may apply for a risk guarantee (whereas the type of geothermal power project –hydrothermal or EGS– is not specified). Only pure geothermal projects can apply; hybrid systems are not considered. The maximum guarantee is 50% of the subsurface costs (drillsite constructions; well drilling and completion for production, borehole geology, injection and observation wells; borehole logging and instrumentation; pumping tests; reservoir stimulation; circulation tests; chemical analysis). The new risk coverage system strongly relies on the experience with the first system. New element is the source of financing: the National Grid Company (NGC). For applicability the geothermal facilities must provide at least 1.5% electricity utilization degree, as defined by a diagram (Figure 2).

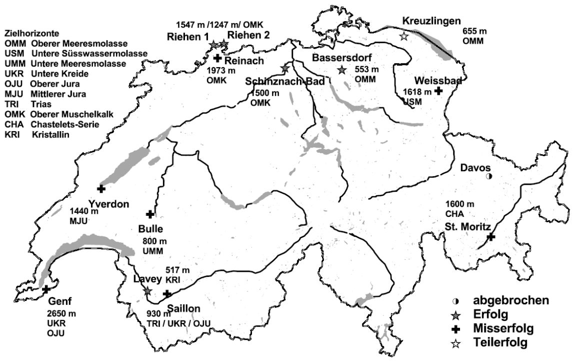

Figure 1: Geothermal drillings of the first Swiss Risk Coverage System and its results. Legend at bottom right: "abgebrochen" = project cancelled, "Erfolg" = success, "Misserfolg" = failure, "Teilerfolg" = partial success. From Rybach (2005).

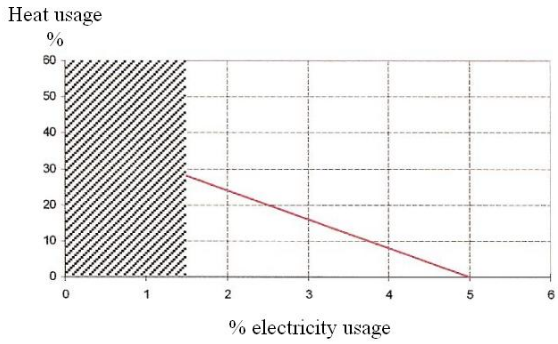

Figure 2: Required usage degrees for geothermal facilities to be eligible for risk coverage, as defined by the Swiss Federal Electricity Supply Ordinance.

Project developers must submit a detailed application to the National Grid Company, covering issues like technical details, expected yields, success/failure criteria, financing aspects, the users of electricity and heat, and the legal entity of the production company. The Swiss Federal Office of Energy (SFOE) deals with the application and appoints an expert panel for review and evaluation. For the drilling phase the SFOE appoints a project guide who evaluates the results and reports to the expert panel about success, partial success, or failure. The panel in turn reports to the National Grid Company who decides about payments. Detailed information can be found in German on: http://www.admin.ch/ch/d/sr/7/734.71.de.pdf.

4. RISK INSURANCE SCHEMES

With the progress in geothermal development in countries like Germany the commercial insurance sector started to show increasing interest for extending its business activities also into the geothermal domain. Although there are still many issues to de clarified (the new interest and the corresponding activities have just started) some features already become visible and certainly more will follow. Besides, so far an insurance scheme has only be applied once (exploration risk insurance for Unterhaching/Germany, Well no. 1; with a premium of 1 M€). Therefore only a snapshot of the current scene can be given in the following.

Interesting insight and information has been provided by the IGA – World Bank GeoFund Workshop on Geological Risk Insurance in Karlsruhe, Germany (11th-12th, November 2008). Representatives of several key insurance companies have presented their approach, Interestingly not only the exploration risk (finding the expected yield) but also the risk during production have is being considered. In general terms the risk with geothermal production facilities thus comprises three components: 1) drilling and testing (operational risks, liabilities), 2) well productivity (insufficient yield and/or temperature), and 3) resource/equipment degradation during production (e.g. colmatation in reservoir or piping). Insurers consider to provide Productivity Guarantee Insurance PGI: the PGI for geothermal drilling sites insures the risk of finding geothermal reservoirs, which do not have sufficient discharge for a feasible economic development of a geothermal project (Schneider, 2008).

Experienced insurance companies require competent project preparation and future usage: sufficient geologic data to reliably determine the Probability of Success (POS; currently insurers require POS > 80%), trustworthy project organization and management, realistic business plan (Schmidt and Müller, 2008). The POS is determined from probability density functions, mainly for geothermal fluid yield and temperature; these can be derived form geologic data.

From the point of view of an insurer like Munich Re several issues need to be excluded from a geothermal risk insurance: insufficient water quality, loss of hole, loss of drilling fluids, time delays during drilling operations, non-compliance with service specification, financial problems of the customer, gross negligence/ willful act, infidelity, fraud, sabotage (Jakob, 2008).

The key issue is to determine an insurance premium, high enough for the insurer and at the same time payable by the insured. Basic elements of premium calculations are: project location, geological situation, quantity/quality of available information/data, risks involved, individual needs of insured, scope and extent of coverage (partial losses also?), insured sum, deductibles, cost of capital (Jakob, 2008).

It can be expected that in the near future several insurance contracts will be signed. With increasing experience with the risk insurance schemes as well as due to market competition a system will evolve that will further help geothermal development.

The World Bank provides a geological risk mitigation instrument for geothermal development projects, supplied partly by the Green Environment Facility (GEF) and the GeoFund Program, as can be seen from Figure 3. In particular, the scheme comprises a GEF grant-backed experimental instrument in a contingent grant scheme, the grant is payable on geologic risk events during the exploration phase, and an envisioned collaboration between the World Bank and the private sector for possible co-insurance (Shimazaki, 2008).

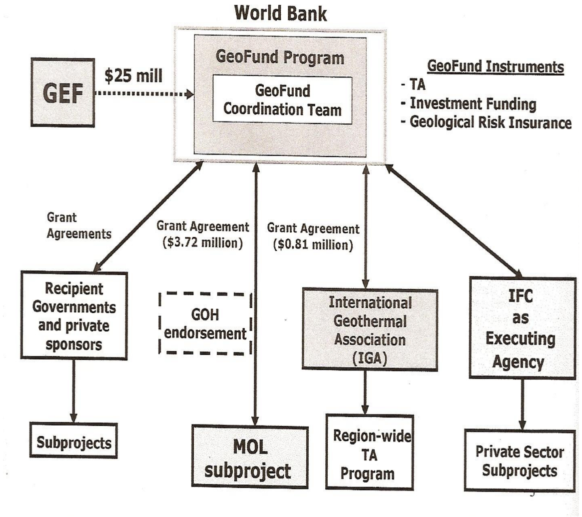

Figure 3: World Bank - GeoFund institutional arrangements (from Shimazaki, 2008).

5. FURTHER SUPPORTIVE LEGAL INSTRUMENTS

5.1 Intitial Governmental Financing

First of all the Governmental support at the beginning of geothermal development must be emphasized. In the sense of kick-off financing the private sector needs encouragement and guidance. An ideal scheme would be when Governments would finance the exploratory and preferably also the pre-feasibility phases of geothermal development; investors would take over when it is already known where to go.

An astonishing development can be seen in Australia: a large number of commercial companies is now active in developing power plants of the Enhanced Geothermal Systems (EGS) type, quite a number of them is on the stock market. Since the grant of the first Geothermal Exploration Licence (GEL) in Australia in 2001 through year-end 2007, 33 companies have joined the hunt for renewable and emissions-free geothermal energy resources in 277 licence application areas covering ~219,000 km2 in Australia. This represents a 152% increase in applications in the last year, but leaves vast prospective areas still to be licensed for geothermal exploration energy. The associated work programs correspond to an estimated investment of AUS$852 million (49% increase since year end 2006) over the period 2002-2013, and that tally excludes deployment projects assumed in the Energy Supply Association of Australia's scenario for 6. % (~5.5 GWe) of Australia's baseload power sourced from geothermal resources by 2030 (Goldstein, 2008).

All this would not have been possible without a substantial financial engagement of the Australian Government. .In the time period 1st January 2000-31st December 2007, the Australian Federal Government has awarded AUS$30.3 million to foster progress towards commercialising geothermal energy resources and cognate technologies. Details of these awards are provided in Table 4.

Table 4: Federal Australian, South Australian State (SA) and Queensland (Qld) State grants awarded for geothermal Research/Proof-of-Concept (including exploration geophysical surveys, drilling and well surveys/tests), and Demonstration projects in Australia 2000 – 2007. From Goldstein (2008).

Grant	Date	Recipient company	Project	Amount ($AUS)
Fed. RECP	2000	Pacific Power/ANU	Hunter Valley geothermal project	$... 790,000
Fed. START	2002	Geodynamics Ltd	Habanero project	$ 5,000,000
Fed. REEF	2002	Geodynamics Ltd	Habanero project	$ 1,800,000
Fed. GGAP	Mar 2005	Geodynamics Ltd	Waste heat fuel for Kalina Cycle power	$ 2,080,000
Fed. REDI	Dec 2005	Geodynamics Ltd	Habanero project, Cooper Basin, SA	$ 5,000,000
Fed. REDI	Dec 2005	Scopenergy Ltd	Limestone Coast geothermal project, SA	$ 3,982,855
SA PACE	Apr 2005	Petratherm Ltd	Paralana geothermal project, SA	$ 140,000
SA PACE	Apr 2005	Scopenergy Ltd	Limestone Coast geothermal project, SA	$ 130,000
SA PACE	Apr 2005	Eden Energy Ltd	Witchellina project, SA	$ 21,000
SA PACE	Dec 2005	Geothermal Resources Ltd	Curnamona geothermal project, SA	$ 100,000
SA PACE	Dec 2005	Green Rock Energy Ltd	Olympic Dam geothermal project, SA	$ 68,000
Fed. REDI	July 2006	Geothermal Resources Ltd	Frome Geothermal Project	$ 2,400,000
Fed. REDI	Dec 2006	Proactive Energy Developments Ltd	Novel regenerator for adapting supercritical cycles for power generation	$ 1,224,250
SA PACE	Dec 2006	Torrens Energy Ltd	Heatflow exploration, Adelaide Geosyncline	$ 100,000
SA PACE	Dec 2006	Eden Energy Ltd	Renmark (Chowilla) geothermal project	$ 100,000
SA PACE	Dec 2006	Geodynamics Ltd	High temperature borehole image logging, Habanero 3, Cooper Basin	$ 100,000
Fed. REDI	Feb 2007	Petratherm Ltd	Paralana geothermal project	$ 5,000,000
SA Grant	May 2007	Univ. of Adelaide	Induced seismicity protocols	$ 50,000
SA Grant	May 2007	Univ. of Adelaide	Research endorsed by the AGEG	$ 250,000
Qld Grant	Sep 2007	Univ. of Queensland	Geothermal energy research	$15,000,000
			Total to year 2007	**$43,336,105**

5.2 Further Governmental Instruments – the USA Example

Several schemes have been developed, introduced, and successfully applied in the USA to trigger and foster geothermal development. The funding can either come from Federal or State sources.

Here only a selection can be listed (mainly after Bloomquist, 2008):

GeoPowering the West Initiative: Launched in 2001 by the United States Department of Energy with the goals of boubling the number of states (four to eight) generating electricity from geothermal energy by 2006, and provision of geothermal energy to 7,000,000 homes by 2010.

The Federal Geothermal Steam Act of 1970: defined the development of geothermal steam and associated resources on Federal lands (currently in revision).

The Public Utilities Regulatory Policy Act (PURPA): was enacted by U.S. Congress in 1979. PURPA for the first time ever allowed for the generation of electricity by non-utility companies, thus creating the private power industry. PURPA also requires that utilities provide transmission and backup service at a reasonable rate.

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

The Geothermal Loan Guarantee Program (GLGP): Loan guarantees could be granted for up to 75% of the project costs with the Federal government guaranteeing up to 100% of the amount borrowed.

The Federal Production Tax Credit (PTC): has been extended in 2005 and is available for wind, closed-loop biomass, and geothermal generation projects. For geothermal a 1.8 UScent/kWh tax credit is applicable, in addition to the business investment tax credit.

The Energy Improvement and Extension Act of 2008 extended PTCs for geothermal power plants for another two years, or through 2010. New geothermal projects coming on line before December 31, 2010 will receive the full 2.0 cent/kWh production tax credit for each of their first ten years of production. Also, in the 2008 Act, homeowners would receive a $2,000 tax credits for installing heat pumps until 2016, and for nonresidential systems, up to 10% of the total geothermal system costs. Both residential and nonresidential systems are exempt from the Alternative Minimum Tax (Lund, 2008).

6. GUIDELINES FOR INVESTORS INTERESTED IN GEOTHERMAL DEVELOPMENT

Geothermal development poses risks but provides at the same time opportunities, on a worldwide scale. Not only the nature of the geothermal resource can vary with location, also the market conditions, the public policy, and the legal framework can vary form country to country.

A recent publication (FORSEO, 2008) describes financial as well as technical issues relevant to investors when considering engagement in geothermal development. In particular, a roadmap (Figure 4) is presented through all phases of project development, demonstrating the risks and costs, and providing comprehensive insight into all relevant aspects. Detailed market information and a close look at financing options are included as well as examples from Chile, China, Germany and USA.

7. CONCLUSIONS, OUTLOOK

Several legislative and regulatory measures are available (or at least conceivable) for stimulating and supporting investors in order to engage themselves in geothermal development, especially in the power generation sector. A number of instruments (feed-in tariffs, risk coverage or mitigation schemes, various governmental supportive measures) that provide a favorable legal environment for investors have been described and examples presented. Legislation is by nature quite different in different countries; as a medium term goal a harmonization should be attempted, for example in the European Union.

Investor behaviour in times of financial instability is unpredictable. Nevertheless there is a chance for reorientation of investors, namely from unstable financial products towards products governed by natural forces and with environmental benefits.

In any case, the role and involvement of governments will be decisive. Government policy and the legislative environment is already favorable for investor engagement in geothermal development in several countries; other countries can be expected to follow.

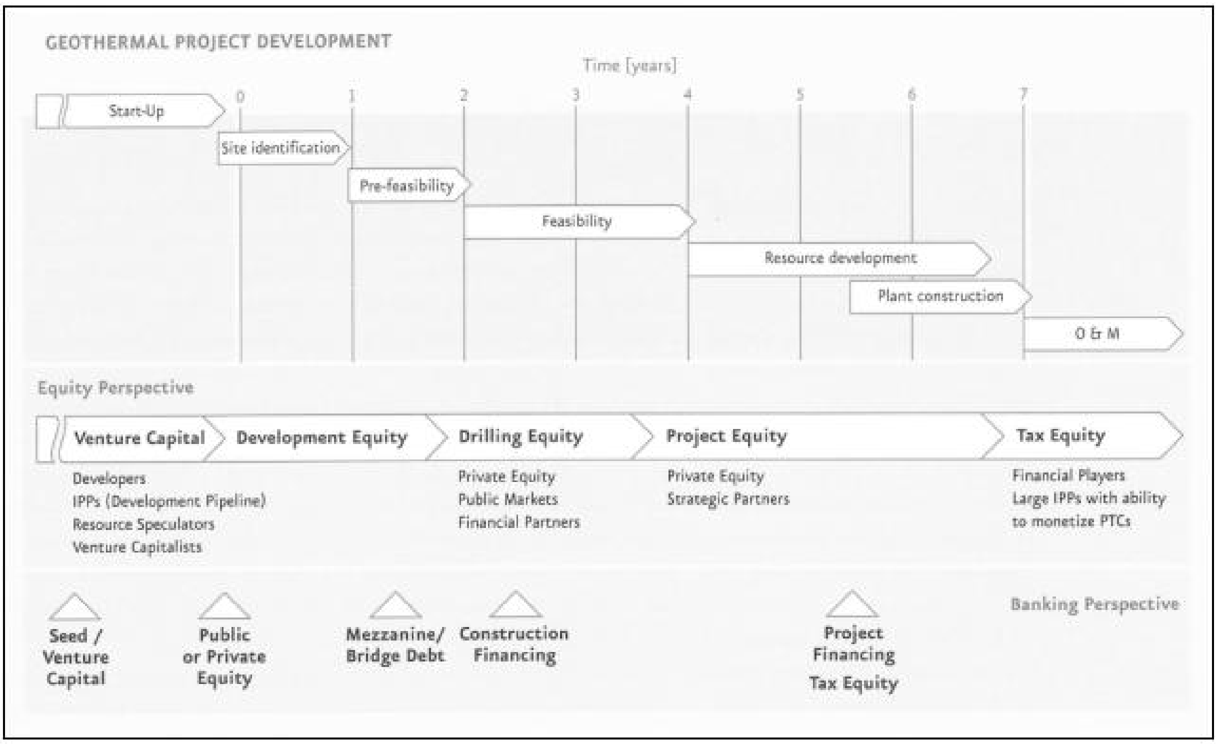

Figure 4: Roadmap of geothermal project development (from FORSEO (2008), modified).

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