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List of legal and economic deficiencies

Non-technical barriers of geothermal development

Title	**List of legal and economic deficiencies - Non-technical barriers of geothermal development**
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CONTENTS

1. INTRODUCTION

In TRANSENERGY countries - similar to several other European countries - there is little limitation from the resource-related side for the enhanced utilization of hydrogeothermal resources, nevertheless only a small number of energetic projects have been realized. Many of the barriers have regulatory-financial nature that substantially inhibits the further development of the geothermal market. Legal conditions play an important role for the security of investment, while financial incentives are required for the realization and the achievement of demanded profitability of a geothermal project.

There is a relatively low rate of return of the investment in geothermal energy and the economic risk is higher as compared to other energy sources. To be able to reach the NREAP targets (2009/548/EC: Commission Decision of 30 June 2009 establishing a template for National Renewable Energy Action Plans under Directive 2009/28/EC), there is an urgent need to highlight the economic discrepancies, make comparisons, recommendations based on best practices thus improving the energy mix for being less dependent on fossil sources.

Different financial incentive schemes exist in the European Union to support the uptake of geothermal energy. While power generation has several supporting instruments, little provision is available for geothermal direct use, although it saves fossil fuel and thus reduces CO_2 emissions. In most countries, geothermal district heating needs investment support (especially if networks do not exist), reduced interest loans, etc. to become economic. Cascade uses (district heating, industry, agriculture, and other) improves economy, but usually are very difficult to achieve due to business obstacles, distances, etc.

The aim of the present report is to give a general overview on the non-technical barriers of geothermal projects, especially the financial ones, as the legal aspects have been already summarized in details including administrative procedures (steps of licensing) (Lapanje et al, 2011). This summary overview of the available European/International supporting instruments is based on the results of the several EU-financed project dealing with the non-technical barriers of geothermal development [e.g. GEOFAR (Geothermal Finance and Awareness in European Regions), Re-Shaping (Shaping an effective and efficient European renewable energy market), GTR-H (Geothermal regulation framework), GEOELEC (Develop Geothermal Electricity in Europe)], as well as some key-publications (e.g. Ecofys 2011, Salmon et al., 2011). In addition some best practices (Germany, France) are presented where sufficient funding of geothermal contributed significantly to the growth of the geothermal sector.

This is followed by an outline of the regulatory-financial framework in the 4 TRANSENERGY countries, focusing on the financial incentives, with the brief summary of the most important conclusions of regulatory barriers.

2. ECONOMIC VIABILITY OF RENEWABLES/GEOTHERMAL COMPARED TO FOSSIL FUELS

Geothermal energy is almost independent from conventional energy prices, because the plant works with energy from the ground. Nevertheless, the comparison of the investment to the conventional energy sources is a key point for the investors. Fossils energy prices are playing an important role (as “price reference”). This is clearly shown by the fact, that when oil prices increased steadily during the last decade and reached its peak in summer 2008, the number of geothermal projects increased, as the growing price of oil and gas made geothermal solutions more attractive for investors.

Nevertheless, as long as gas prices are cheap, geothermal projects without incentives are not foreseen on a short-mid-term, however it has to be considered that energy security and reduction of CO_2 emissions cannot be priced in a traditional way (i.e. external cots of energy production by fossil fuels should be also considered when comparing prices).

3. FINANCING GEOTHERMAL PROJECTS

3.1. General aspects

In a planning phase of a geothermal project, the basic question is how much it would cost (including CAPEX – capital investment costs, OPEX – operational expenses and external costs, considering possible cost reductions (e.g. carbon taxes, tax credit). From the part of revenues it has to be considered how much energy/heat will be produced, and at what price produced energy can be sold. Market conditions have to be considered, too, e.g. there is a free market, or it is set by regulations (e.g. feed-in-tariff, etc.).

Profitability is a key point for an investor. The operating plants create revenue from sales of electricity, or heat (or both). Multiple utilization has to be considered already at the beginning of the project because it creates news possibilities for revenues during the operating phase.

Each project has many stakeholders: consumers, suppliers, developers, governments, operators, financial institutions. They all contribute to the defining of the economical and financial terms of the project and all of them have multiple interests. The financial institution will focus on the viability and the risks of the project and will expect the debt repayment, while the investor will put the return on equity of the project in centre. All these considerations have to be taken into account to assess the viability of the project.

Making generalities on geothermal project (costs, time schedule) is difficult: power generation and heating production are clearly two different technologies. Additionally the characteristics of the project depend on the location, capacity expected from the plant, natural conditions, needs in surface, etc. Nevertheless some general considerations can be drawn.

Quality and quantity of the geothermal resources are the key and necessary conditions for a successful geothermal project. The resource characteristics that influence the costs vary with location (e.g. temperature, depth and permeability of the reservoir, size, and fluid flow rate); therefore the increase of exploration costs is always worthwhile. In addition to resource related factors, geothermal development costs also depend on location, drilling market, size of development, number and type of plants used, and whether the project is greenfield or expansion (in the latter case costs are10-15% less).

In comparison to other renewable energy technologies, geothermal energy projects have high up-front costs (mainly due to the costs of exploration, like seismic investigations, reprocessing and drilling wells) and capital investment (CAPEX, such as plant installation), however low operational and maintenance costs (OPEX) (Figs 1, 2). The CAPEX is up to 55-65% of total cost of geothermal power. The operational costs vary to a great extent from one project to another (size, quality of the geothermal fluids, etc.) but are predictable in comparison with power plant on the basis of traditional energy sources which are submitted to the market hazard.

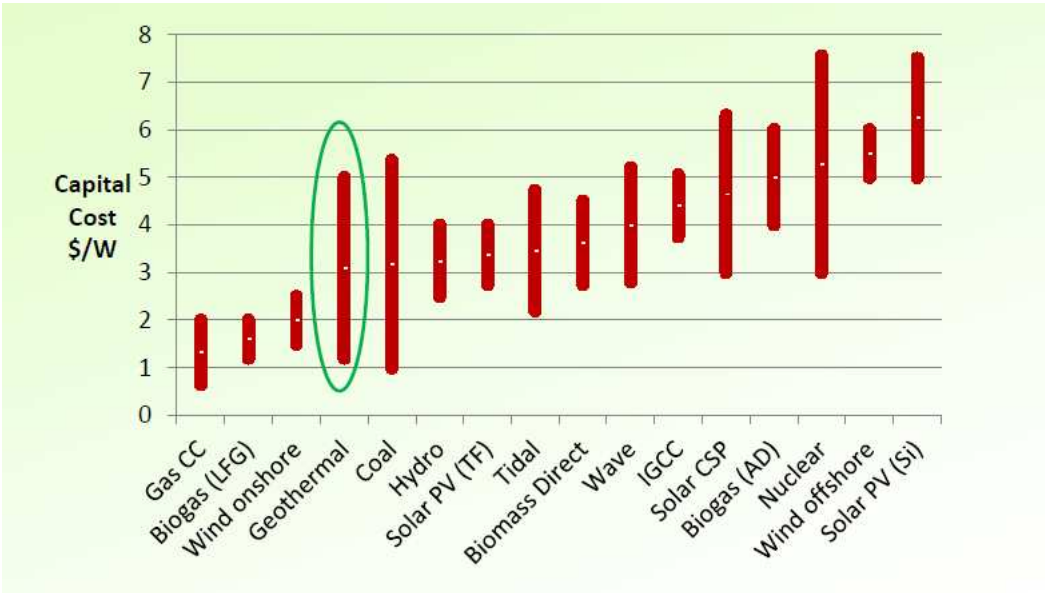

Fig. 1 Capital costs of geothermal compared to other RES (source: Clean Energy Trends 2010)

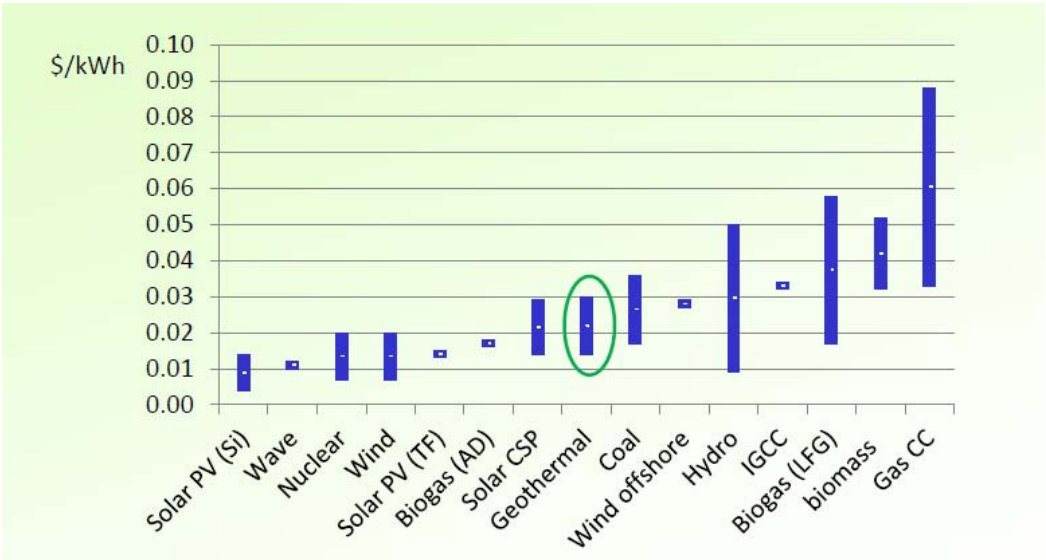

Fig. 2 Operational costs of geothermal compared to other RES (source: Clean Energy Trends 2010)

CAPEX for conventional geothermal electricity is 1000-3800 €/kW, while at EGS it can be as high as 10000-26000 €/kW. Capital costs for a lower temperature binary plant can range between 2400-5900 $/kWe. Estimated levelised generation costs for lower temperature resources is app. 200 $/MWh. Typical operational and management costs are app. 25 $/MWh for small binary plants, excluding well replacement drilling costs (IEA, 2010).

For geothermal district heating and/or combined heat and power (CHP) low-medium enthalpy systems are utilized, which may be critical in making the project economically viable. District heating projects involve high volumes of investment for heat distribution (pipes), unless an

existing network can be used. Costumer density is crucial economic factor, e.g. existing heat demands have to be identified during a heat-market analysis. Nevertheless direct use of geothermal energy for heating purposes can be competitive with conventional energy sources. In Europe, geothermal district heating costs are about 55-165$/MWhth, averaging 68 $/MWhth. Capital costs of geothermal systems for direct space heating range between 1700-3950 $/kWth (IEA 2010).

3.2. Financing different stages of a geothermal project

Analyses of investment costs and risks underline that the financing of the exploration phase of a geothermal project is an important, even if not the most important barrier (Fig. 3). During the exploration phase, the risk is high while the costs are already significant as e.g. seismic data has to be purchased or seismic investigations have to be conducted. One of the largest obstacles for investment in deep geothermal systems is that the presence and quality of the resource is not proven until the first exploration well is drilled. On the other hand exploration wells have a relatively low success rate (20-60%). In consequence, only if the flow rate and temperature fulfil the expectations of the investor (e.g. profitability), it can be determined that the project achieves its objectives. The reduction of the risk that is coming from limited geological information can be covered by government through geological exploration (drilling, seismic profiles, etc.) funded by the state.

An unsuccessful drilling is an important risk that has to be taken and to be paid. Drilling costs are significant and can represent a non negligible part of the overall project costs, however have to be financed somehow.

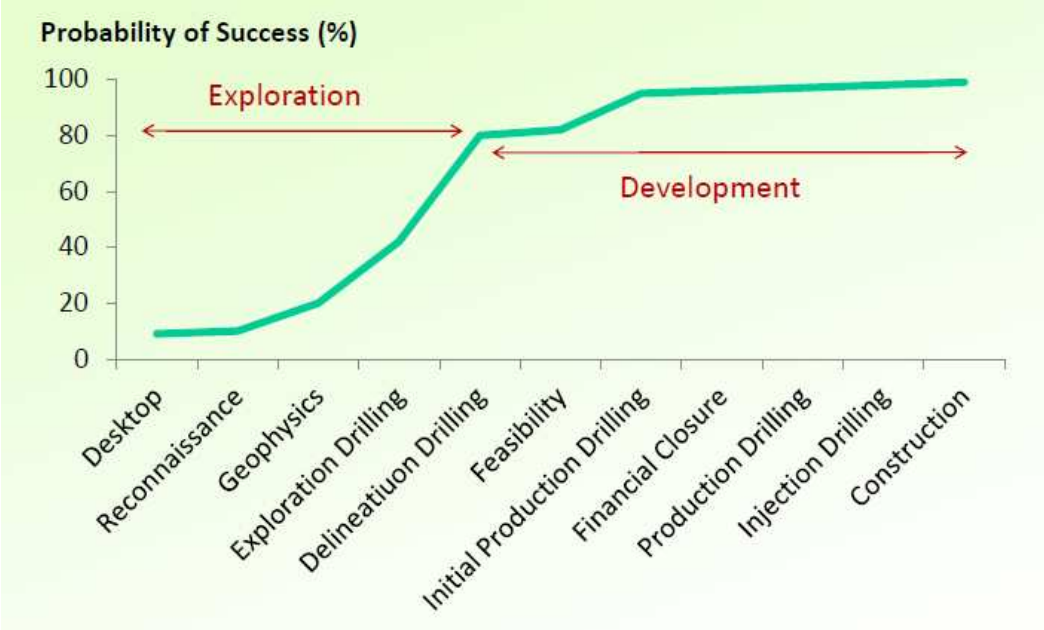

Fig 3: Variation of risks at different phases of a geothermal project: risk is exponentially growing in the exploration phase (most in the drilling phase) and much less in the development phase (source: GEA, 2008)

Drilling costs are typically 30-50% of total development costs and can vary from a few 10000 € to several million €. There are different factors which influence the costs of drilling, such as the depth, fluid chemistry, the temperature and pressure of the resource. The different aspects

of drilling technology also influences a lot the costs, furthermore depth is a critical factor: cost grow sometimes exponentially with drilling depth (Fig. 4)

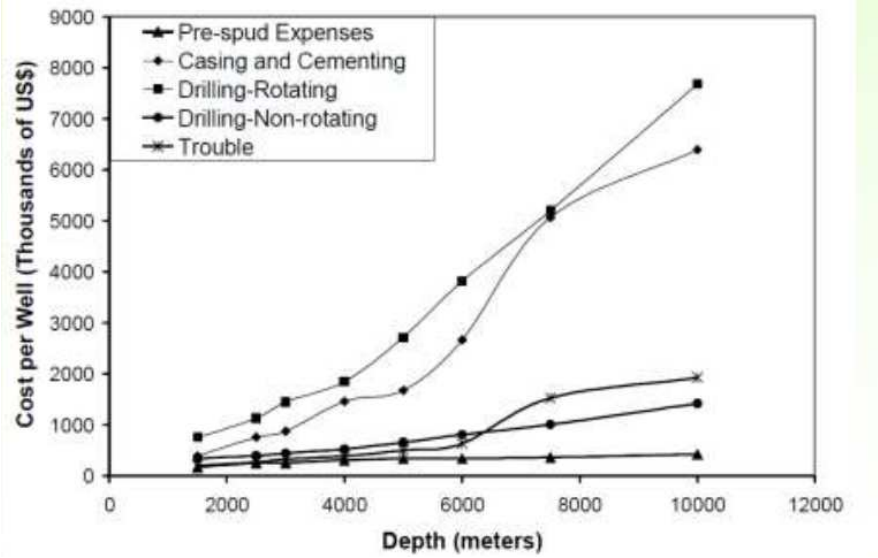

Fig. 4: Increase of different costs of a drilling with increasing depth (source: GEA, 2008)

Financial institutions argue that for traditional financing the risk is too high to lend at this early stage of the project. They will wait with providing loans to the geothermal projects until the existence and the quality of the resource has been proven. Therefore equity from own resources, or grants from public bodies could cover these expenditures. Private equity investors will expect a high rate of return at these first stages of the project due to the risk their investment still faces. Finally, classic project finance schemes can be used at a very late project phase. Aspects of different types of required financing at different project stages are shown on (Figs 5 and 6).

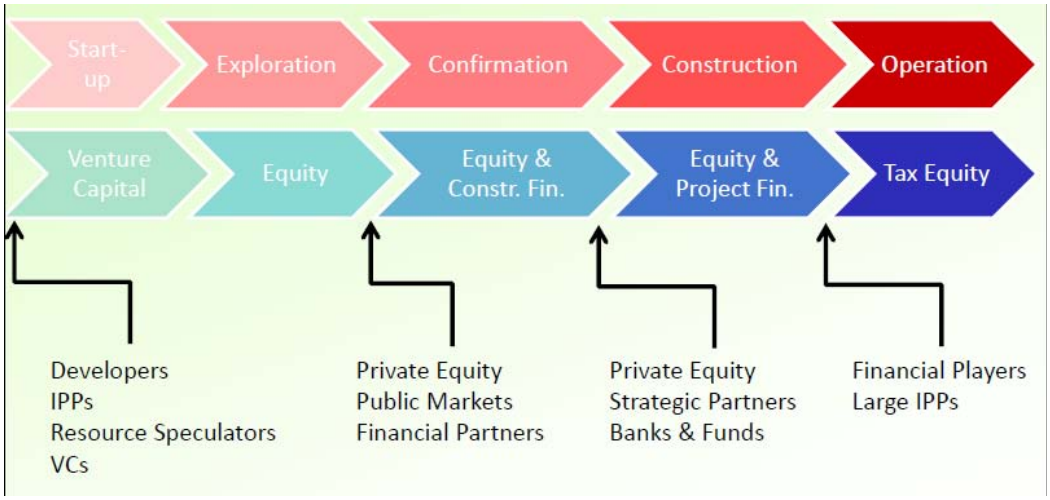

Fig. 5: Financing stages of a geothermal project (adapted from Islandsbanki)

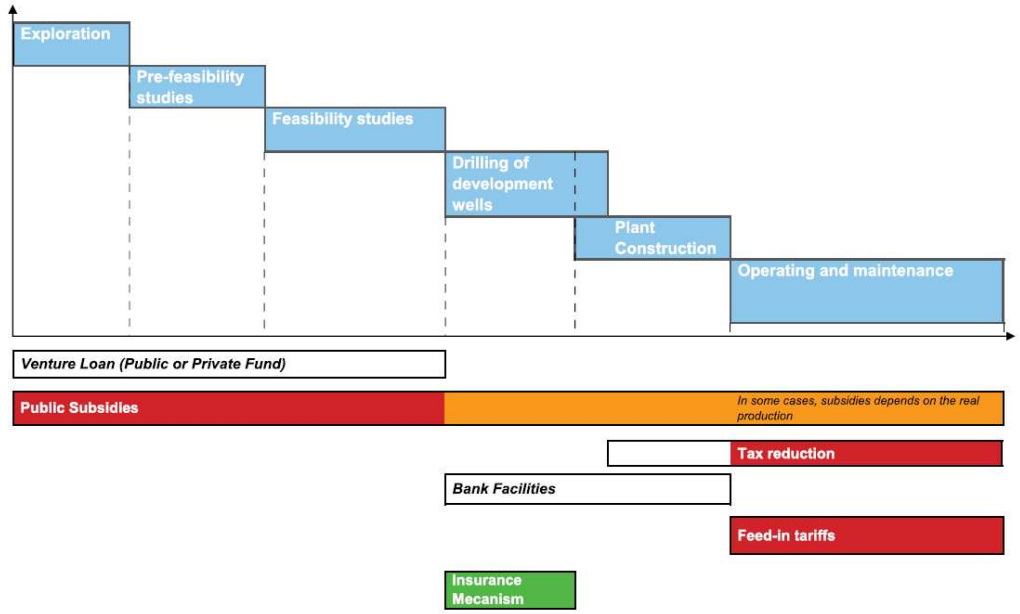

Fig. 6 Phases of geothermal project and financing instruments (Geofar)

4. ECONOMIC INSTRUMENTS

There is a wide variety of economic instruments which either support, or inhibit the enhanced use of geothermal energy. There is a wide range of supporting instruments, including tax exemptions, guaranteed take-over prices, green certificates, direct subsidies, etc. Grants can reduce the amount of investments and feed-in tariffs regulated by law increase and fix revenues during the operational phase. Therefore a combination between financing scheme and incentives can be a key point for the economic success of projects. The next chapter gives a general overview of these funding schemes. A special focus is set on the geological risk insurance mechanisms that guarantee the presence and the quality of the resources. This could be a key aspect to overcome the difficulties.

Nevertheless the financial burden of fiscal nature (i.e. mining royalty, sewage penalty, groundwater use fee, environmental tax) can be multiple (like in Hungary, Slovakia and Slovenia).

4.1. Supporting instruments

There is a wide range of different types of supporting instruments. All these instruments have the purpose to increase the profitability, by offsetting the high up-front costs and payback period of the project, so as to attract investors. Bank facilities dedicated to geothermal energy projects are uncommon, while governmental incentives, as tax reduction, guaranteed feed-in tariffs and grants, are quite general.

4.1.1. Direct subsidies

Subsidies are the main instruments for supporting investments. The investment cost becomes lower and the profitability gets higher, which enlarges business opportunities. Subsidies are offered at national level, but mainly at regional level. Subsidies support mainly the investment

phase (e.g. drilling of wells). Nevertheless subsidies also have disadvantages, e.g. when the subsidy expires, there will be no market/profitability for the systems that have evolved during the time of subsidies. The market players have to adapt to the new situation and the timeframe for sustainable growth might be postponed.

As creation of a market takes a period of 5 - 10 years, the subsidy has to be valid over a long time period. The introduction of a subsidy must be clear: e.g. what is the nature of the subsidy, available amount, time-frame, eligibility criteria, how to apply, etc. The transition from a period of a certain subsidy to another or to a time without subsidies must be very smooth.

Public subsidies are the only way to finance the exploration phase (see also geological risks, chapter 4.1.8.). Funds dedicated to research and demonstration programs could be another way, but nothing systematic can be found on European level.

4.1.2. Loans

Special bank facilities with low interest loans unfortunately rarely exist for geothermal.

4.1.3. Tax incentives

A common form of governmental incentives is VAT reductions, different tax exemptions, which can concern both electricity and heat production.

4.1.4. Feed-in tariff / feed-in premium

The feed-in tariff is a strong incentive to promote electricity from renewable energy. It means that “green electricity” is bought by utilities at above market price. This is necessary because the retail price of electricity generated from renewable sources (including geothermal) is typically higher than the retail price of electricity generated from fossil fuels. A feed-in tariff is a revenue-neutral way of making the installation of geothermal energy more appealing. Lenders are interested in long-term sustainable projects with high profitability. The feed-in tariffs are a long-term guarantee as the contract is signed for a given period at a fixed price. The guarantee period should be long enough to make this instrument totally viable. Feed-in tariffs for geothermal energy are in most cases lower than for other renewable energy sources.

Under feed-in premium regimes, renewable electricity generators receive a feed-in support payment in addition to their revenues from selling electricity in the spot market. Over the last years, a trend towards feed-in premiums can be observed.

4.1.5. Off-take and support scheme for green-heat

Feed-in tariff doesn’t exist for heat production. Heat production has no long-term guarantee that production will be sold to a fixed rate (except for France “Fond Chaleur”, see chapter 5.2.).

4.1.6. Carbon credits

The European Union Greenhouse Gas Emission Trading Scheme (EU ETS) for carbon dioxide emissions can cover financing of geothermal energy projects, like in the NER 300 program (see details in chapter 4.2.7.).

4.1.7. Indirect support schemes (RDI programs, pilot programs, best practices)

The European Union allocates funds for research and pilot projects; these are discussed in details in chapter 4.2. Some countries also dedicated money to promote research and development of new demonstration projects, geothermal energy can benefit from.

4.1.8. Risk insurance

Investment into geothermal is highly risky, especially compared to other renewables. Resource exploration, confirmation and site development carry uncertainty that make financing more expensive. Wells drilled in the exploration phase typically have a success rate of 20-25% at new sites. Drilling makes up to 80% of costs in the confirmation phase of geothermal development (and up to 30-40% of total project costs). Consequently, any investment in a production drilling has to be considered as a venture of the investor, as there is always the risk of total or partial loss of the investment, i.e. capital. Therefore the geological risk during exploration is being considered to be the main barrier for an increased project implementation.

Getting a loan for the investment of a geothermal project is difficult, as most banks will not lend money to high-risk projects. Mitigating the risk is necessary to realise the investment. Such geological uncertainties are specific to the geothermal activities and traditional insurance policies do not offer any specific solutions for this type of risk. Detailed financial guarantees designed to cover project investors against the geological uncertainties specific to this activity could secure the financing of a project.

Insurance mechanisms are not financial instruments in the common sense as they are not a way to obtain money to explore, or to increase the profitability of the project, however they are a key point to boost investment in geothermal energy.

Currently, only a few European countries provide such a risk-sharing system for geothermal projects (France, Germany and Switzerland). At international level, GeoFund provided also a partial insurance system for GeoFund member countries. Furthermore there are private enterprise insurance solutions available which have to be negotiated on an individual basis and include high insurance premiums.

4.1.8.1. The French risk insurance system

The French risk insurance system differentiates between 2 types of risks. The first one is the risk during the drilling phase of not obtaining geothermal resource matching the flow rate and temperature requirements enabling to assure the profitability of the planned operation (“Short Term Risk - STR”). The second one is the risk of seeing this resource, when it exists and is exploited, decreasing or disappearing before the amortization of the equipments, as well as the risk of damage affecting the wells, the material and the equipment of the geothermal loop during the exploitation period (“Long Term Risk - LTR”).

For STR, and in case of total failure (quantity and quality of the resource), the fund can cover up to 90% of the total cost of the first well (depending on the more or less favourable regions).

For LTR, in case of damage that leads to the guarantee application, the compensation amount will depend on the consequences of the damage and the measures to remedy it. Duration of the insurance contracts is 20 years. The insurance rate is a fixed yearly amount.

The risk insurance is managed by SAF Environnement, which is a subsidiary of the Caisse des Dépôts et Consignations (majority), and other public and private financial establishments. Public or semi-public investors (local communities, subsidized housing organisations, hospitals and joint investment companies) or private operators can apply. SAF-Environment is authorized by the government to implement and manage the Fund guarantees geological and geothermal risks (Geothermal Fund AQUAPAC Fund)

4.1.8.2. The German risk insurance system

To take over the risk of non-discovery the German Federal Environmental Ministry (BMU) has developed a risk mitigation instrument focused on geothermal drilling projects. The instrument is focused on the drilling phase of projects with at least two deep drillings (development drilling and injection drilling) that will be connected to a primarily cycle. It provides a loan with identification clause (in case of not successful drilling) and redemption grant. The loan can be combined with a redemption grant for accrued costs for stimulation. This leads to higher interest rates during drilling. It is managed by KfW Bankengruppe (see also chapter 5.1.).

The main barriers and financial instruments as well as their strengths and weaknesses are summarized in Figs 7 and 8.

Main barriers		**Financial instruments**
High up-front costs		public subsidies
		venture loans
Geological risk		subsidized insurance mechanism
Long pay-back period	High investment costs	bank facilities (e.g. subsidized interest loans)
	Low profit	feed-in tariff for electricity
		off-take and support scheme for green heat
		tax reductions
	Lack of security for investment	No long-term guarantee for exploitation rights
		no long-term guarantee for electricity and heat sell prices
		Fluctuations and cheap price for fossils

Fig. 7 Main barriers and related financial instruments (Geofar)

Instruments offered	Main strengths	Main Weakness
Feed-in Tariffs	Secure income over a long term period	Acts at a very late project stage
Tax reduction	Promote increased capital investment	Affects mainly operational phase when revenues are generated
Grants	Substitute equity	Management of public money
Bank Facilities	Possibility to finance projects with high investment volumes	Difficult to apply in the stage of exploration without insurance mechanism
Tradable certificates/Quota systems	Deals with very few public money	No long term secured and fixed income

Fig. 8 Main strengths and weaknesses of financial instruments (Geofar)

4.2. European / International financial instruments

At European level several instruments for supporting investments in renewable energy projects, including geothermal, are established. These instruments tackle with different project phases. In the following section a short description is provided on those most important support schemes.

All European financial instruments follow the European Union economic main policy objectives:

- Cohesion and convergence promotes developing regions within the EU and is key to the integration objectives of the Union
- Support of small and medium sized enterprises (SMEs) is of central importance for the EU's economy and employment
- Innovation supports the goal of establishing a competitive, innovative and knowledge-based European economy.
- Promoting sustainable, competitive and secure energy sources.
- Support of human capital, notably health and education.

4.2.1. Research and Development – FP7

The European Union promotes Research and Development, in particularly in the field of renewable energy over the FP7-Energy programme. The objective of energy research under FP7 is to aid the creation and establishment of the technologies necessary to adapt the current energy system into a more sustainable, competitive and secure one, thus it provides support for the early phase of a geothermal project. The EU Member States and the European Parliament have earmarked a total of € 2.35 billion for funding this theme over the duration of FP7, which includes renewable electricity generation, as well as heating and cooling from renewables (including geothermal). Nevertheless the financing of geothermal projects from FP7 was very low, only 2 projects were funded (GEISER - Geothermal Engineering Integrating Mitigation of Induced Seismicity in Reservoirs - EC contribution: €5,308,869.00 and GROUND-MED - Advanced ground source heat pump systems for heating and cooling in Mediterranean climate - EC contribution: €4,548,944.00).

4.2.2. Intelligent Energy Europe Programme

The programme is a pillar of the EU's Competitiveness and Innovation Framework Programme (CIP) and supports EU energy efficiency and renewable energy policies with a budget of € 730 million which is made available through annual calls for proposals to support projects putting the concept of 'intelligent energy' in practice, carried out by public, private or non-governmental European organisations. In that way this program area does not contribute directly to the execution of geothermal projects, but supports the establishment of a competitive and transparent environment. The increase the share of renewables in the production of electricity, heat and cooling, and to integrate them in the local energy systems are funded within the ALTENER program. Several geothermal projects got support, e.g. Geoelec, GeoDH, GTR-H, IGEIA, REGEOCITIES, etc.).

4.2.3. European Investment Bank (EIB) and European Investment Fund

The European Investment Bank as the long-term lending bank of the European Union can play a key role in the investments, and particularly concerning environmental projects The EIB raises substantial volumes of funds on the capital markets and lent it on favourable terms to projects. For geothermal energy projects it offers loans and venture capital, thus support project at their early stage. All kind of project promoters are eligible with a well-developed business plan. Normally 50%, possibly 75% of project cost are funded, minimum project size for direct loan is 25 million Euros (total project cost). Smaller projects are served through project aggregation through an intermediary. Loans are granted to viable capital spending programs or projects in both the public and the private sector. Counterparties range from large corporations to municipalities and small and medium-sized enterprises. Requests for venture capital should be addressed directly to an intermediary. EIF makes investments in venture capital funds that support SMEs, particularly early-stage and tech-orientated enterprises.

EIB is interested in projects with a high-quality geothermal resource that can remain viable in the long run without subsidies. It sees geothermal energy as a mature technology which however for the time of its existence cannot deliver the projected increased efficiencies of other emerging technologies such as photovoltaic, solar, offshore wind power, tidal and bio fuels. Currently EIB does not fund projects in early stages, but only projects which have proven their economic viability, i.e. exploitation.

4.2.4. European Bank for Reconstruction and Development (EBRD) - Renewable Development Initiative

The EBRD is the largest single investor in the region and mobilises significant foreign direct investments beyond its own financing. It invests mainly in private enterprises, usually together with commercial partners. For financing renewable energy projects the EBRD has set up the Renewable Development Initiative. It funds projects from €5 million - €250 million: provides loans (minimum €5 - 15 million), equity minority positions with a clear exit strategy, guarantees, investment funds. The EBRD funds up to 35% of the total project cost for a Greenfield project or 35% of the long-term capitalisation of an established company. Smaller projects (investments range generally between € 500,000 and 6 million) may also get funded: loans, equity, leasing, technical assistance, all through qualified financial intermediaries. Equity share target range is 25-30% but up to 49% is possible. Only commercial companies may apply, or an intermediary authorised to act for them.

4.2.5. JASPERS, JEREMIE and JESSICA

The European Commission has launched these three initiatives to enhance the support for start-ups and micro-enterprises, through technical assistance, grants, as well as non-grant instruments such as loans, equity, venture capital or guarantees, and highlights the added value of undertaking these actions in cooperation with the EIB group. Support is given to activities in selected or all EU member states. Deep geothermal energy projects can be the beneficiaries of the support over the country specific activities.

JASPERS - Joint Assistance in Supporting Projects in European Regions - covers practically the new Member States and acceding countries of the EU, as well as EU regions covered by the new Convergence Objective for the period 2007- 2013. The main objective of JASPERS is to assist the Member States in the complex task of preparing quality projects so that they can be approved more quickly for EU support by the services of the Commission. JASPERS provides comprehensive assistance for all stages of the project cycle from the initial identification of a project to the Commission decision to grant assistance. Public authorities are eligible to apply for technical assistance on larger projects (costing more than €25 million).

JEREMIE - Joint European Resources for Micro to Medium Enterprises. Regional policy managing authorities (i.e. public entities) in Member States that wish to join the JEREMIE framework, decide to allocate resources from the programme to a holding fund. The holding fund such as venture or seed capital fund, start-ups, technology or technology transfer fund, guarantee or mutual guarantee fund, loan fund, micro credit provider, etc. is managed by financial intermediary. Micro, small or medium-sized enterprises are eligible to apply.

JESSICA - Joint European Support for Sustainable Investment in City Areas – provides equity and loan participation from urban development funds which selects and supports urban projects (in the field of geothermal typically heating and cooling), providing them loans, equity or guarantees, but not grants. Project promoters are eligible to apply who can be public, municipal or private sector enterprises, or joint enterprises involving these actors in any possible combination of them.

4.2.6. Structural Funds and Cohesion Funds

Structural Funds and Cohesion Funds are funds allocated by the European Union for two related purposes: support of the poorer regions of Europe and support of integrating European infrastructure. Current programs from 2007 to 2013 have a budget of 277 bn € for Structural Funds, and 70 bn € for the Cohesion Fund.

Renewable energy and energy efficiency projects realized on local level can be some of the best options to use the funds effectively. To draw down EU Structural Funds each Member State must submit a National Development Plan to the European Commission, setting out its investment priorities for EU Structural Funds. This plan forms the basis of negotiations between the Member State Government and the European Commission relating to the allocations of EU funding. The maximum contribution of the funds to a project depends on the type of project and where it takes place. Basically each project needs national co-financing. For the tangible financing of geothermal projects at national level, the respective Operational Programme has to be checked

4.2.7. Emission Trading System and NER 300

The European Union Greenhouse Gas Emission Trading Scheme (EU ETS) for carbon dioxide emissions in the European Union, based on Directive 2003/87/EC can cover geothermal energy projects. This system works with the implementation of National Allocation Plans in European countries introducing allowances for some sectors and individual installation. The EU ETS works on the 'cap and trade' principle. A'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. After each year a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances.

The NER300 program is funded from the sale of 300 million emission allowances from the New Entrants Reserve (NER) set up for the third phase of the EU Emissions Trading System (ETS). The funds from the sales are to be distributed to projects selected through two rounds of calls for proposals, covering 200 and 100 million allowances respectively. The aim of NER300 is to establish a demonstration programme comprising the best possible CCS and RES projects and involving all Member States. NER300 funding is expected to leverage a considerable amount of private investment and/or national co-funding across the EU, boost the deployment of innovative low-carbon technologies and stimulate the creation of jobs in those technologies within the EU. Based on the sale of the first 200 million allowances, a maximum of €1.5 billion was available to co-fund successful projects under the first call for proposals. In December 2012, the European Commission made a funding award of over €1.2 billion for 23 highly innovative renewable energy demonstration projects, where the only geothermal related is an EGS pilot project in Hungary with a total funding of 39,295,008 €. The Commission intends to launch the second call for proposals on 3 April 2013.

4.2.8. GeoFund

The Geothermal Energy Development Program aims at systematically promoting the use of geothermal energy in the Europe and Central Asia region by removing barriers to the development of geothermal energy, leading to greater diversification in energy use and an increase in demand for and the supply of geothermal energy projects. The GeoFund is funded

by the Global Environment Facility (GEF) Trust Fund and is managed by the World Bank. The GEOFUND support offers comprise:
- Providing technical assistance and capacity building to transfer know-how and to establish a geothermal data base and capacities to develop and implement geothermal energy projects;
- Supporting capital investments in geothermal energy development projects;
- Supporting reforms in policies, and the legal, regulatory and institutional framework of the energy market.

For policy and institutional reforms governments and other public institutions (i.e. municipalities, government agencies) can apply. For projects to be financed utilities (private or public), investors, banks, etc. are eligible. A total amount of 25 Mio US$ is eligible in GeoFund for geothermal energy projects.

4.3. Financial burdens

Geothermal projects are often burdened by multiple taxing, i.e. have to pay mining royalty, as well as groundwater use fee. In those cases where the thermal water is not re-injected, but let into surface discharges, the waste water fine is higher than for balneological users. These issues are mostly related to the regulatory framework and were discussed in details in Lapanje et al. (2011).

5. BEST PRACTICES

5.1. Germany

Germany is often cited as a good example in Europe, showing how much the financial supportive tools can contribute to the high growth rate of renewables in a country with moderate natural setting. The support system summarised here is based on Gassner (2010) and Imolauer et al (2010).

The main mechanism for promoting deep geothermal energy in Germany is the legally stipulated feed-in tariff structure for electricity from geothermal energy. Since 2009, this legal framework has been supporting not only geothermal power generation, but also the combined generation of heat and electricity.

The successful market introduction of renewable energy sources for electricity generation is strongly dependent on the feed-in tariffs provided for by the German Renewable Energy Sources Act (EEG). The basic principle of the EEG is that the operators of electricity supply grids are obliged 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. These regulations mean that project developers, investors and operators can reliably calculate yields for the first 20 years of operation. The state itself is not involved in financing, but instead merely controls the framework conditions and checks at regular intervals whether the regulations are having the desired effect.

The tariffs are specified for each renewable energy source so that an appropriate level of profit can be made. The tariff amounts depend on the plant size and other factors; various bonus payments create incentives for certain technologies which are particularly favourable to the environment or are particularly innovative. The tariffs currently range from 3.5 €cent/kWh (for large hydroelectric plants) to 43 €cent/kWh (smaller photovoltaic systems on buildings).

The feed-in tariff is 20 €cent/kWh for electricity from geothermal energy plants that have an electricity capacity of up to 10 MW and go online by 2015. In addition, there has been a

heating-use bonus of 3 €cent/kWh since 2009 when electricity generation is combined with high-quality provision of heating energy. A further bonus of 4 €cent/kWh is paid when electricity is generated using petrothermal technology, which is still in its development stages.

The Renewable Energy Heat Act (EEWaermeG), which took effect in 2009, is a first step towards utilising the potential offered by the use of renewable energy sources to heat buildings. It obliges building developers to source a minimum percentage of the energy requirement for heating and hot water from renewable energy sources. The minimum percentages for each type of energy are set down in law such that no particular technology is favoured. The minimum percentage can also be achieved by combining different types of energy. Particularly efficient thermal insulation can also be used as an alternative. The obligations of the EEWaermeG only apply for new buildings. However, the German federal states can also oblige the owners of existing buildings to use renewable energy sources. For example, a regulation in Baden-Wuerttemberg requires that at least 10°% of the heat requirement must be supplied via renewable energy sources when the heating system in an existing building is replaced. It is too early to evaluate whether the EEWaermeG promotes leads primarily to the use of individual shallow systems, and to what extent it supports classic centrally sourced district heating networks which can be supplied with geothermal heat.

In addition to EEG and EEWaermeG which intend to increase the utilisation of renewable energy sources without state subsidies, direct state support is also available in Germany. This provides state subsidies for the construction of geothermal heating stations, district heating infrastructure and for shallow geothermal systems. As a recent addition, state support is now available to cover drilling and exploration risks (see also chapter 4.1.8.2.). The measures are grouped in a so-called Market Incentive Programme (MAP) which consists of multiple modules tailored for each type of renewable energy and specific use aspects. It is established in Directives of the Federal Ministry for the Environment on the Promotion of Measures for the Utilisation of Renewable Energies in the Heat Market. These directives are adjusted on an annual basis.

The MAP contains three different modules for promoting deep geothermal energy. Pure geothermal heat generating systems are eligible for a repayment subsidy of up to € 2 million for construction and expansion, and up to € 2.5 million per borehole. Systems which also generate electricity, or which generate electricity only, are excluded because they are seen as sufficiently subsidised via the feed-in tariffs as laid out in the EEG. Thus the MAP incentives take the place of the EEG subsidies for pure geothermal heating stations.

The drilling and exploration risks can be covered both for electricity generation systems and for pure thermal use. Deep boreholes with special technical drilling risks may be granted a repayment subsidy of 50% of the additional expenses above the planned figures, max. € 1.25 million. In order to cover the exploration risk, a new, separate credit programme has been on offer since February 2009. The operator receives a loan to finance up to 80 % of the drilling costs. If previously defined yields are not reached, than he is released from repaying the loan. The subsidy module was developed in cooperation of the German Federal Ministry for the Environment with the insurance industry. Guarantees for drilling and exploration risks are subject to strict application conditions and comprehensive audits of individual cases. The exploration risk is evaluated by independent experts, and the overall economic viability of the project is examined before granting the loan.

A further subsidy module is the promotion of district heating infrastructure, which is supplied with heat from renewable energy sources. Subsidies of up to € 1.5 million can be awarded for infrastructures powered by geothermal energy.

The funds are applied for via the respective principal bank and awarded by the state Reconstruction Loan Corporation (Kreditanstalt für Wiederaufbau, www.kfw.de). Eligible applicants include municipalities, legally dependent municipally-owned enterprises, special-purpose associations, small and medium sized enterprises (SME), large enterprises in cases of special funding eligibility, as well as private individuals and private foundations that use the produced energy solely to meet their own needs. The financing share is up to 100% of the eligible net investment costs. A maximum loan amount of usually EUR 10 million per project can be granted by the KfW.

In addition research is also supported in Germany: for demonstration projects in Heating & Electricity & Cogeneration, a demonstration programme has been set by the Federal Ministry of Environment (BMU). The programme provides bullet loan with interest subsidy (KfW) and in special cases investment subsidy. For the bullet loan with interest subsidies the amount of financial support can be up to 70 % of the fundable costs without a limit. An investment subsidy for up to 30% of the fundable costs can be applied for in exceptional cases. National and international private companies, mainly public sector dominated companies, municipalities, municipality associations; owner operated municipal enterprises, administration unions and county administrations can apply.

5.2. France

France is another European country, where the support of geothermal energy is outstanding, especially related to heat generation.

To boost electricity production from renewable, the law compels the French electricity grid operator to buy electricity from renewable at a fixed price. The tariffs are guaranteed minimum payments, which may be increased by a premium. The amount of tariff is set by a specific order (arrête) for every single source of energy. The scheme is primarily based on Article 10 of the Law on the Modernisation of Public Electricity Services (Loi n° 2000-108). Payment is given for the duration of 15 years. The feed-in tariffs have been increased since 2006. For geothermal power production with contracts signed since this date, the tariff is 20 cent€/kWh for plants < 12 MW. In France, geothermal projects receive a bonus payment for using the heat content in addition to the generation of electricity. The payment rate is on a sliding scale relative to the proportion of heat used. The maximum payment is 8 cent€/kWh of on top of the base rate.

The Heat Fund (Fond Chaleur) provides grants for investments in the heat sector. The rate of the grant is calculated in a way assuming that the heat is sold at least 5% cheaper than it is by using fossil energy (gas being usually the reference). All projects will be studied case by case. It is necessary to be insured through the geological risk insurance to obtain these subsidies (see chapter 4.1.8.2.). For the period 2009-2011 960 millions € were dedicated to this Fund (for all renewables) by the French Finance law for 2009-2011. Private or public operators can apply to this fund.

To decrease price of renewable energy, the French government reduced the VAT rate for district heating with renewable sources of production. The reduced VAT rate applies for renewable heating, including geothermal energy for the two parts (connection and energy) of the final user contracts. VAT rate of the energy consumption decreases from 19.6 % to 5.5 % if an average of more than 60% (50% by the end of 2009) of the energy comes from renewable energy sources.

In addition to the above described governmental incentives, the French Environment and Energy Management Agency (ADEME) offers special grants for geothermal energy, at

national level but overall at regional level (assisted in some regions by the Regional Council). These grants are financing feasibility studies and investments to geothermal projects up to 50% of the cost of the study, limited to 300,000 € for deep geothermal energy. A specific grant can be added for a consultant assisting the project owner (30% of the sum, limited to 100,000 €).

6. AVAILABLE FINANCIAL SUPPORT SCHEMES IN TRANSENERGY COUNTRIES

6.1. Direct subsidies, funds and loans

There is very little and scattered information about these supporting instruments in the TRANSENERGY countries.

For example, in *Slovenia* in 2004/05 Public Fund of the Republic of Slovenia for Regional Development and Preservation of the Settlement of Slovene Rural Areas supported eight geothermal projects (drilling for exploration wells) with 0.8 million € funding and 0.6 million € loans. The Ecological Development Fund of Slovenia (ECO – fund) was established in 1994 by the Ministry for Environment and Spatial planning. It is a public fund, which operates with the capital from state budget, World Bank and European Investing Bank loans, privatization funds and PHARE funds. ECO – fund at present credits mostly water supply systems, sewage systems and waste treatment plants, etc. It supports the use of geothermal energy as well, but there hasn't been much inquiry for crediting from the users.

In *Hungary* Pannergy, the most successful company in establishing large geothermal district- and town heating systems elaborated an attractive financial model together with the municipalities, which is partly co-financed by European Banks. If the geological analysis made in the framework of the cooperation agreement states that an effectively operating power and/or heating plant can be built, Pannergy and the local municipality establish a project company: a limited company with HUF 100 millions share capital. Pannergy and the co-financing European banks (EIB, EBRD) suggest that the ownership of the municipality be 10%. Upon the establishment of the project company the municipality is required to pay HUF 10 million which will be lent by Pannergy to the municipalities as a maturity of 5 years without interest or any costs to be paid. It is stipulated in the agreement that the municipality should use its capital bonus, as its dividend to repay its credit facility. The agreement also contains a matrix, which indicates the municipality's possible payment depending on the capacity of the geothermal power plant to be built and the size of the possible EU fund.

In *Slovakia* the state role in support of the geothermal energy sources is through government funded projects of the geological exploration and prospection (deep hydrogeological or geothermal wells) that, to certain level, mitigates risks due to geological uncertainty. That means government supports the geothermal industry by providing the relevant geological, hydrogeological and geothermal information of the geothermal structures, through detailed studies with evaluation of geothermal resources. The support of the systematic prospection for geothermal resources funded by governmnet started in 1993 (Government Resolution no. 619 and the National Council Resolution. 339 approved the "Strategy, policies and priorities of state environmental policies with the further evaluation of prospective geothermal areas defined fundamental research"). Requirement and support for the continuation of these geological work was subsequently listed in the National Sustainable Development Strategy (October 2001) and the Concept of geological research and exploration of the territory of the Slovak Republic in 2006 (prospectively until 2010), which was approved by Government Resolution no. 334.

There are few examples of direct investment by the private sources or financial institutions and loans but no systematic scheme is present concerning direct investment schemes. This includes for example the drilling of the well in central part of Slovakia (Žiar nad Hronom, well RGŽ-2) funded by private sources and international bank institution. Another example is running facility for district heating in Galanta, Galantaterm Ltd. The most part of the project implementation was covered by long term loan from Nordic Investment Bank Helsinky (NIB). The loan was received via SPP a.s. (Slovak Gas Enterprise, joint stock company) and the loan is covered by governmental guarantee. Other example for various funding sources is for the intended electricity production (but till today not running) in Košická kotlina Basin, site Ďurkov (wells GTD-1, GTD-2 and GTD-3). The first study was performed by companies Slovgeoterm Ltd. and French CFG Orléans, co-financed by PHARE projects funding (http://www.geoterm-kosice.sk). The initial investment in drilling was financed by PHARE projects funding and SPP a.s.. Several tests and seismic measurements were financed by the Danish environmental government partnership (DEPA fund) (http://www.geoterm-kosice.sk). The former project for Kosice city heating counted with the financial support of the European Union funds on the level of 30% and the rest financed from the bank loans (http://www.cassovia.sk/news/7785). The project for the electricity generation might be funded by the loan from financial institution, EU structural funds, or SPP a.s. (information Meyer in http://www.24hod.sk/clanok-90730-Geoterm-ide-stavat-pri-Durkove-geotermalnu-elektraren.html).

There are as well other projects funded by private financial source, though the information is not available nowadays.

In *Austria* there are no federally governed loan procedures existing yet. Subsidies have been awarded in the past by the national states of Austria or by the European Union (ERDF funds).

6.2. Tax incentives

In Slovakia, electricity is subject to a consumption tax except if it is produced by renewable energy. Geothermal energy in theory would benefits from the exemption of tax on the consumption of renewable-energy-source electricity (at the moment there is no geothermal-based electricity production). The amount of tax is calculated on the basis of the amount of electricity tariffs.

Otherwise this supporting instrument is not available in the other TRANSENERGY countries.

6.3. Feed-in tariff/feed-in premium

There is no geothermal-based power generation in the TRANSENRGY countries, except for Austria. Nevertheless the Hungarian and Slovakian NREAP-s foresee geothermal-based electricity by 2020 (Slovenia does not), so feed-in-tariffs will become relevant in the future.

At the moment feed-in-tariff system exist in Slovenia, where the guaranteed purchase prices for electricity from RES generating plants using geothermal energy is 152,47 €/MWh for small (< 1 MW) plants. Where the annual useful heat extraction exceeds 30% of the input geothermal energy, the RES generating plant is eligible for payment of a supplement amounting to 10% of the operating support for this RES plant. Operating support for electricity from RES generating plants using geothermal energy (feed-in premium) is 103,59 €/MWh in small (< 1 MW) plants. Where the annual useful heat extraction exceeds 30% of the input geothermal energy, the RES generating plant is eligible for payment of a supplement amounting to 10% of the operating support.

In Slovakia the feed-in tariff (in general) is 80.91 €/MWh.

The current Austrian feed-in-tariff for geothermal is too low (7.44 €cent/kWh) to promote any investments.

The takeover price of the electricity produced from geothermal energy was about 10 €ct/kWh in Hungary, but the feed-in tariff system is presently suspended; the revision of the system is under preparation.

6.4. Off-take and support scheme for green-heat

This supporting instrument is not available in any of the TRANSENERGY countries.

6.5. Carbon credits Emission Trading System and NER 300

The European Union Greenhouse Gas Emission Trading Scheme (EU ETS) for carbon dioxide emissions party covers financing of geothermal energy projects in the frame of the NER 300 program.

Based on the sale of the first 200 million allowances, a maximum of €1.5 billion was available to co-fund successful projects under the first call for proposals. In December 2012, the European Commission made a funding award of over €1.2 billion for 23 highly innovative renewable energy demonstration projects, where the only geothermal related is an EGS pilot project in Hungary with a total funding of 39,295,008 €.

6.6. Indirect support schemes (RDI programs, pilot programs, best practices)

TRANSENERGY countries were not successful in FP7 energy related projects, however they participated some IEE/Altener projects (e.g. GeoDH, GTR-H).

Most of the EU funds for TRANSENERGY countries were available through the different “energy-related” operative programs financed by the Structural and Cohesion Funds.

6.6.1. Slovenia

Renewable energy in general (and geothermal) may get financing from the *Operational Programme for Developing Environmental and Transport Infrastructure* 2007-2013 (OP DETI) in Priority axis 6. Sustainable use of energy where altogether 5.800.000 € was allocated for hydroelectric, geothermal and other renewable energies.

The Support for electricity produced from renewable sources / Podpora proizvodnji električne energije iz obnovljivih virov is managed by the eEnergy Directorate (the program owner is the Ministry of Infrastructure and Spatial Planning of the Republic of Slovenia). It supports deployment; investment or operation.

Furthermore there is a call for tenders "Energy restoration of public buildings under the Operational Programme of Environmental and Transport Infrastructure Development for 2007-2013, 6 development priority "Sustainable Energy Use", 1 preferred orientation "Energy restoration and sustainable construction of buildings" in which funds are allocated through public tenders in the form of subsidies to use heat supply form RES. The target groups are municipalities, legal entities. Out of funded 170 projects only a few were geothermal-related. The range of support is 200.000 € to 6.000.000 €/project, 85% to 100% eligible investment costs are funded.

6.6.2. Hungary

The *Environment and Energy Operational Program* 2007-2013 is owned by the Ministry of National Development, the program managing organisation is the National Development Agency, National Environment and Energy Centre.

The EEOP has 7 priority areas out of which 2 are related to geothermal: Priority 4: Increase the use of renewables (396 million EUR) and Priority 5: Energy efficiency (386.5 million EUR).

The overall targeted program indicators (by 2015) are:
• renewable energy utilization (electricity and heat): 29.3 PJ/year
• renewable-based electricity production: 937 GWh/year
• reduction of GHG emission: 1400 kt/year
• saved energy (due to increased efficiency): 2.7 PJ/year

The target groups of the program are SME-s, larger companies, non-profit organizations, private companies, companies operating from the state-budget (typically municipalities).

Priority area 4: Renewable Energy: Increasing renewable energy utilisation aims at contributing to the enhancement of security of supply, to the decrease of import reliance, and furthermore to fulfil the environment and climate protection policy related goals. The implemented operations support (among others) geothermal electric and/or thermal energy generation and utilization and heat pump systems.

The following projects were financed between 2007 and 2011:

KEOP-4.1.0. (Support of heat/power generation from renewables): 3 projects, total support: 2, 53 million €

KEOP-4.2.0. (Local heat and cooling supply from renewable sources): 10 projects, total support 14.87 million €

KEOP-4.7.0. (Subsidy of the preparing and developing activities of the geothermal based heat and electricity producing projects): 2 projects, total support 2.08 million €

The EEOP program is the most efficient and major supporting scheme for geothermal projects in Hungary. The experience was that the lack of prove of own resources, guarantees and elongated licensing procedures were the main problems during the period of contracting, while in the period of project implementation itself, mostly the changes in the technical content of execution, and the not sufficient proofs of performances caused delays.

6.6.3. Slovakia

The *Operational Programme Environment* is owned and managed by the Ministry of Environment of the Slovak Republic. Its Priority axis 3 (Climate protection and minimization of negative impacts of climate change), Action 3.2 (Minimizing adverse impacts of climate change, including the promotion of renewable energy), Group I (Reducing greenhouse gas emissions along with the reduction of emissions of pollutants in the production of heat, including changes in fuel based energy sources to renewable energy sources) provides support for geothermal projects. The following types of projects may get funded:

Projects focused on change in the carbon based fuels into the ones with less carbon emissions and toward the renewable energy sources (biomass, solar energy, geothermal energy) aimed at reducing greenhouse gas emissions along with the reduction of emissions of pollutants in the heat in public buildings in several municipalities or micro level.

Projects focused on change in the carbon based fuels into the ones with less carbon emissions and toward the renewable energy heat sources or in combination with cogeneration. The project may also include measures to reduce energy losses objects (heat source).

Construction or reconstruction of primary and remote distribution for district heating systems (to improve insulation and reduce distribution pipeline leakage of energy carriers, including adjustments to heat exchanger units) only as part of the change in fuel base to a heat source

(possibly in combination with cogeneration) to reduce emissions primary pollutants, provided that the heat pipes have one applicant.

The budget for the 2007-2013 period for Priority axis 3 (Climate protection and minimization of negative impacts of climate change) is 211 764 706 EUR, with a rate of co-financing of 85%.

The *Operational Programme Competitiveness and Economic Growth* is also owned and managed by the Ministry of Environment of the Slovak Republic. Its Priority axis 2 (Energetics - Power engineering), Action 2.1 (Increasing energy efficiency in production and consumption and the introduction of progressive technologies in energy) provides support for geothermal projects. The following types of projects may get funded:

- investment projects for high-efficiency cogeneration of electricity and heat within the rules of no. 2004/8/EC, with a maximum installed capacity of 10 MWe,

- build a connection to the electricity grid, only in combination with the construction of facilities for the use of renewable energy sources within the scheme,

- investment projects on renewable energy, e.g. construction, modernization and reconstruction:

- equipment for geothermal energy (excluding exploration wells)

- investment projects on renewable energy, e.g. construction, modernization and reconstruction:

  - facilities for the use of aerothermal and hydrothermal energy using heat pumps

  - equipment for geothermal energy (excluding exploration wells) or by using the direct use of the heat pump.

The budget for the 2007-2013 period for the Priority axis 2: Energetics - Power engineering is 198 631 059 EUR, with rate of co-financing 85%.

6.6.4. Austria

Such “energy-related” operative programs financed by the Structural and Cohesion Funds do not exist in Austria.

The program called *eMISSION.at!* is owned (financed) by KLIEN (Klima- und Energiefonds) and managed by Österreichiche Forschungsförderungsgesellschaft FFG. The program lasts from 2012 to 2017. It provides funding for R&D activities in alternative energies, smart grids and energy storage. The programme aims to fund cooperative research between scientific organisations and SMEs. It is focussing on applied research and also intends to develop prototypes as well as pilots. Its budget is app. 10 million €. Funding is 40% (industrial partners, SME-s) to 80% (research organisations) of entire costs. Nevertheless geothermal energy only plays a minor role at this programme (around 5% of funded projects).

6.7. Risk insurance

This supporting instrument is not available in any of the TRANSENERGY countries.

7. FINANCIAL ASPECTS OF DEMONSTRATION PLANTS IN THE TRANSENERGY PROJECT AREA

In the frame of a feasibility study, which was prepared for direct heat utilization in the area of Ács-Gönyű-Zlatá na Ostrove area and for a geothermal power plant at Csömödér (Geothermal Express Ltd. 2012), calculation were also made for the costs of the project and their planned income and payback times (Tables 1, 2)

Process	Cost, HUF million
Further seismic acquisition, processing, evaluation. Project technical planning.	2 x 35 = 70
Project management, licensing	2 x 40 = 80
Underground facilities: drilling four wells (~2200 m deep), well completion, reservoir stimulation	4 x 425 = 1 700
Surface technology: land acquisition, heat pipelines, heat exchangers	2 x 325 = 650
Consumers' system with heat centres	2 x 350 = 700
Financing costs (~10% of the Budget)	300
Total	3 500 HUF3,500 million (€6.18 M)1 € ~ 283 HUF in November 2012.

Financial calculations	
Calculated heat energy price:	HUF3500/GJ (12.36 €/GJ).
Annual supplied heating and cooling energy:	55,000 GJ/doublet.
In the next decade cooling demand is to be significantly increased. It was considered during the determination of the energy demand (~ 10,000 GJ/doublet is cooling energy in summer time).	
Annual planned income:	HUF192.5 million/doublet (€0.68M).
Total annual planned income:	HUF385 million/doublet (€1.36M).
Payback time:	9.1 years.

Table 1: Planned costs and financial calculations of the Ács-Gönyű-ZlatánaOstrove Project

Process	Cost, HUF million
Further data processing, evaluation. Project technical planning.	20
Project management, licensing	60
Underground facilities: drilling four wells (~2700 m deep), well completion, testing, reservoir stimulation	4 x 800 = 3 200

Surface technology: ESP, land acquisition, heat pipelines, injection pumps, filters	320
Fabrication and installation of the power plant machinery	1 300
Connection to electric grid and heat consumers	300
Financing costs (~10% of the Budget)	550
Total	5750 HUF5,750 million (€20.3 M), 1 € ~ 283 HUF in November 2012.

Financial calculations	
Planned feed-in tariff:	30 Ft/kWh (10.6 €cents/kWh)
Heat energy price:	HUF3500 /GJ (12.36 €/GJ)
Electricity production time:	8300 hour/year
Annual produced electricity:	16.6 million kWh
Annual produced heat energy:	55,000 GJ
Annual income from electricity:	HUF500 million (€1.77 million)
Annual income from heat supply:	HUF192.5 million (€0.68 million)
Total income:	HUF692.5 million (€2.45 million),
Payback time:	8.3 year

Table 2: Planned costs and financial calculations of the Csömödér Project

8. SUMMARY OF REGULATORY BARRIERS IN TRANSENERGY COUNTRIES

The legal aspects have been already summarized in details including administrative procedures (steps of licensing) (Lapanje, A. et al, 2011). Therefore here only a series of tables is provided which provides a transparent comparison of the most important barriers related to the regulatory frameworks (Tables 3 - 9).

	SLO	HU	AT	SK
Ownership of geothermal energy	state	state	land owner	state
Drilling depth	shallow: < 30 m deep: > 300 m (GSHP)	deep: Not specified in the Mining Act KvVM 101/2007 (XII.23.): water licence for < 30 m	shallow: < 300 m deep: > 300 m	shallow: < 300 m deep: > 300 m
Temperature of thermal water	Not defined in legislation, in practice: 20 °C	30 °C	20 °C	20 °C

Table 3: General framework: Geothermal installation and utilisation classification / parameters

SLO	HU	AT	SK
Ministry of Agriculture and Environment (water management) 1. Environmental Agency of Slovenia	Ministry of Rural Development (water management) 1. Nat. Env. Institute and its territorial units → water management 2. Inspectorates („green authorities")	Federal Ministry of Agriculture, Forestry, Environment and Water Management (water management)	Ministry of Environment (mining, Geological Act!) (water management, environmental protection))
Ministry of Infrastructure and Spatial Planning (mining, energetics)	Ministry of National Development (energetics)	Federal Ministry of Economics, Family and Youth No geothermal, only licence for deep drillings	Ministry of Health (Balneological Act)
	Ministry of Economics (economic development, competitiveness)		Ministry of Economics (energetic utilization of thermal waters)

Table 4: Responsibility of ministries

	SLO	HU	AT	SK
Geothermal concession	Thermal water (>20 °C): water concession 50 years	Exploration and exploitation of geothermal energy below 2500 m 35 (+17,5 years)	No	Right for exclusive "Prospection area" where exploration for geothermal energy is performed.
Mining Act	Geothermal energy utilization without water abstraction is not defined > 300 m: drilling permission (technical)	Geothermal energy utilization without water abstraction	> 300 m: drilling permission (technical)	„Geological Act": covers geological, hydrogeological exploration in broader terms
Act on water management	Geothermal energy utilization with water abstraction	Geothermal energy utilization with water abstraction	Energy content of thermal water is not defined: licensing is not regulated	

Table 5: Concession, different acts

SLO	HU	AT	SK
With water abstraction: Environmental Agency of Slovenia (ARSO)	Above 2500 m (with water abstraction): green authorities (also as valid permission for utilization of geothermal energy)	Local: < 5l/s State authorities: > 5l/s Transboundary: Federal Ministry of Agriculture, Forestry, Environment and Water Management	Hydrogeological Commission of Ministry of Environment : approval for water sources, advisory authority for the minister Licence: Regional Environmental Office
On water protection area, or for drillings deeper than 30 m	Below 2500 m: concession Mining Inspectorate Abstraction of thermal water: based on water licence issued by green authority	On water protection areas: water licence	Reporting to Inspectorate of Spas and Springs (under Ministry of Health) in case of: T>20°C TDS>1000 mg/l CO2 >1000 mg/l H2S >1 mg/l

Table 6: Licensing authorities

	SLO	HU	AT	SK
Drilling depth	-	-	Water protection area > 1000 m	≥ 500 m
Water abstraction / re-injection	Water abstraction > 10 million m3/yr Without reinjection: if fluid temp. is higher with 4°C than air temp., or TDC > 1000 mg/l Water pumping > 100 l/s	Thermal water abstraction > 5 million m3/yr Karstic aquifer > 500 m3/day Intergranular aquifer >2000 m3/day Re-injection >3 million m3/yr	Not regulated	Not regulated

Table 7: Environmental Impact Assessment

	SLO	HU	AT	SK
Compulsory re-injection (water abstraction solely for energetic purpose)	For the entire amount of abstracted water	For the entire amount of abstracted water Derogation depending on the quantity status of groundwater body (2014, 2020) Derogation in Agriculture: 2014.12.22→ 2015.06.30	For the entire amount of abstracted water	No general rules, defined in individual water permits
Surface emittment temperature	Surface water: 30°C Sewage: 40°C	Surface water: 30°C	Surface water: 30°C Sewage: 40°C	26 °C
Chemical threshold values for surface emittment:	Regulated	Regulated	Regulated	Regulated

Table 8: Environmental constrains (re-injection)

Formázott: Francia (franciaországi)

SLO	HU	AT	SK
In water concession, annual reporting to ARSO, details not regulated	Geological data: Hungarian Office for Mining and Geology Water management data: National Water Inspectorate (OVF), National Environmental Institute (NeKI), water directorates	Reservoir data are confidential, no compulsory data supply towards the state, except for summary reports for water and mining authorities	If well production >15 000 m3/year, or > 1250 m3/month Mineral water User: annual report to Slovak Hydrometerological Institute (SHMI) Compulsory reporting and data supply to Geofond (SGUDS)

Table 9: Reporting obligations and data policy

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