Ministry of the Environment

Geothermal Energy Systems Assessment

THEMATIC REPORT

– A Strategic Assessment of Technical, Environmental, Institutional and Economic Potentials in Central and Eastern European Countries

Executive Summary

DANCEE
Danish Cooperation for Environment in Eastern Europe
Ministry of the Environment

Publisher
Ministry of the Environment,
Danish Environmental Protection Agency,
Strandgade 29,
DK-1401 Copenhagen K
Telephone int +45 32 66 01 00
Telefax int +45 32 66 04 79
Internet: http://www.mst.dk

Year of publication 2002

Title
Geothermal Energy Systems Assessment
- A Strategic Assessment of Technical, Environmental, Institutional and Economic Potentials in Central and Eastern European Countries.

Text
This report has been prepared for the Danish Ministry of the Environment by Kvistgaard Consult ApS. However, the report does not necessarily reflect the views of the Danish Ministry of the Environment.

Editors
Morten Kvistgaard (Kvistgaard Consult ApS)
Henrik Egelyng (Kvistgaard Consult ApS)
Carsten Schwensen (Kvistgaard Consult ApS)

Abstract
„This report is an Executive Summary of the thematic main report on strategic assessment of future potentials for geothermal energy systems in Central and Eastern European Countries (CEECs). The analysis includes technical, environmental, institutional as well as economic issues of relevance for future utilization of this renewable energy source in the CEECs. The study provides recommendations on how to increase environmental impacts and benefits in return for project investments“.

Terms
Environment, Central and Eastern Europe, DANCEE, CEE, CEECs, Geothermal, Energy, Renewable

Edition closed December 2001

Number of pages 32

Electronic www.mst.dk/dancee (pdf+HTML)

Number of copies 250

Format A4

Paper 115g. Cyclus Print/ 300g. Zanders mega Matt

Price Free

Cover photos Scanpix, Carsten Schwensen (Kvistgaard Consult ApS)

Printed by Phønix-Trykkeriet A/S, Denmark

ISBN 87-7972-014-5

The printed matter is approved under the Nordic environmental label. Identity number 541 006. This ensures that the printed matter meets the official environmental requirements during its life cycle. Printed on official environmentally approved paper with vegetable-based printing inks.

Geothermal Energy Systems Assessment

DANCEE
Danish Cooperation for Environment in Eastern Europe
Ministry of the Environment

Contents

1 Introduction

The Danish Environmental Protection Agency (DEPA) has, through the DANCEE programme, initiated and co-funded 6 geothermal energy (GE) projects in the Central and Eastern Europe Countries (CEECs) during the past 9 years. A USD 12 million project in Pyrzyce in the western part of Poland was the first demonstration project. Subsequently, projects were launched in Zakopane (Podhale) in the southern part of Poland, in Kleipéda (Lithuania), in Ziar nad Hronum and Kosice (Slovakia) and in Decin (Czech Republic).

The geothermal projects funded and implemented by DEPA were perceived as generally successful and the potential for future development of GE in the CEECs as promising. However, the projects have so far been launched on an individual basis, and they were, - and remain - , separate projects primarily characterised by being initiated from a bottom-up approach and only to a lesser extent guided by coherent strategies.

DEPA consequently contracted Kvistgaard Consult to carry out a Geothermal Energy Systems Assessment (GESA), including a strategic assessment of technical, environmental, institutional and economic potentials for future geothermal energy development in Central and Eastern European Countries.

The GESA was carried out by consultants from Kvistgaard Consult between April 2001 and December 2001 and was divided into 4 basic components:

1) A retrospective study, consisting of an evaluation of 8 geothermal projects (case studies) including the 6 projects co-funded by DEPA. The case studies, in turn, comprise both on site evaluation during project visits and desk analysis of existing information on each project.

2) A prospective study, based on country missions to the five DANCEE focus countries (Poland, Slovakia, Russia, Ukraine and Romania) and desk research.

3) An international workshop on the future of GE in the CEECs held on October 8th - 9th 2001 in Copenhagen. The workshop was attended by governmental representatives as well as project stakeholders from all CEECs covered by this study. Furthermore, delegates from main international financial institutions as well as from Danish Ministries, companies and investments funds attended the workshop.

4) A Strategic Action Plan (SAP), based on material collected from various sources, including actual project proposals received during country missions.

While 12 Central and Eastern European Countries have been considered for this study, special attention has been given to analyse conditions in the five countries defined by DEPA as the DANCEE focus countries: Poland, Slovakia, Russia, Ukraine and Romania. The remaining countries, - the non-focus countries - , are either: 1) Already phased out of the DANCEE programme (Hungary); 2) Currently in the process of being phased out

(Czech Republic); or 3) Subject to DEPA geothermal project funding, but to a lesser extent than the focus countries (Bulgaria, Lithuania and Latvia). Belarus has not been included in the study and Estonia was also excluded due to the country's lack of geothermal potential.

Two volumes have been produced from the GESA study:

1) *Main Report* (Volume I)
2) *Country Profiles and Case Studies* (Volume II)

Furthermore, a Strategic Action Plan (unpublished) has been prepared for DEPA, including concrete project investment proposals.

This Executive Summary comprises the main issues from the *Main Report* (Volume I) and is divided into three main sections:

A Retrospective Analysis (Chapter 2), where *lessons learned* from the DANCEE projects are presented and transformed into a *best practice* project design.

A Prospective Analysis (Chapter 3) containing a comparative analysis of technical, institutional, economic and environmental potentials for future development of GE projects in the five DANCEE focus countries.

Finally, a Strategic Assessment (Chapter 4) where concrete DEPA (DANCEE) action proposals are formulated in view of DEPAs current and potential role as an international key player in relation to GE development in the CEECs.

2 The Retrospective Analysis

2.1 DEPA Geothermal Project Activities in the CEECs

An integrated part of the DANCEE programme support is to promote transfer of environmental knowledge and environmental protection technology from Denmark to CEECs. The effort and experiences generated by Danish geothermal experts have proved very useful in several CEECs, where GE sources have been integrated into CEEC district heating systems. Know-how and expertise from the Danish district heating sector has successfully been transferred to demonstrate new technologies and more efficient heating systems, - including geothermal energy technology for heating purposes.

In total, DEPA has invested more than USD 9 mill. in geothermal projects in the CEECs (see table 2.1-1). This investment, in turn, generated co-funding from international finance institutions and national sources adding up to a total of USD 148 million. From an environmental point of view, these geothermal projects create large potentials for reduction in emissions, - of CO_2 in particular -, from substituting heat generated at coal fired plants.

Table 2.1-1 DEPA Investments in Geothermal Project Activities 1992-2001

Baltic region	Lithuania	Russia[1]	Poland	Slovakia	Romania	Ukraine	Czech Rep.
1992 DEPA: 875 000 USD Geothermal Study	1996-2001 DEPA: 2.5 mill USD Co-funding: 16 mill USD Klaipéda, (Production 530 TJ/y; expected saving in CO_2 emission: 51,900 t/y)	1994 DEPA: 56 250 USD Explorative Study, Kaliningrad Region	1993- 2001 DEPA: 3.3 mill USD Co-funding: 112 mill USD Zakopane: (Production: 1,000 TJ/y; expected saving in CO_2 emission: 210,000 t/y) Pyrzyce: (Production: 670 TJ/y; expected saving in CO_2 emission: 69,000 t/y)	1995-2000 DEPA: 1.5 mill USD Co-funding: 8 mill USD Ziar nad Hronum: (Production: 713 TJ/y; expected saving in CO_2 emission: 72,000 t/y) Kosice: Phase I	1997 DEPA: 85 000 USD Feasibility Study	1996 DEPA: 75 000 USD Feasibility Study	1996-2000 DEPA: 1.1 mill USD Co-funding: 12 mill USD Decin, (Expected saving in CO_2 emission: 25,000 t/y)

1: Danish Energy Agency (DEA)

2.2 Summing Up the DEPA Project Experiences

Visits to project sites and interviews with project stakeholders have produced a series of valuable *lessons learned* from the DEPA projects implemented so far. The main lessons are summarized below (for a more project specific and comprehensive list of lessons learned, please see the *Main Report*, Volume I, and the *Case Studies* in Volume II).

2.2.1 General Lessons Learned

From the consultants' visits to geothermal project areas, it has been clearly demonstrated that preparedness and motivation for the geothermal projects vary considerable, both within countries and between regions. The most successful projects are typically implemented in regions where local people were aware of GE and its potential prior to project implementation and did support the general project idea.

A second general point to be made, is that due to the great complexity of geothermal projects some flexibility may be needed in order to carry out a geothermal project in the most adequate way. This can be done through a division of the project into phases, as it has already been done in some of the projects.

2.2.2 Economic Lessons Learned

The need for new drillings often represents a significant economic risk for the projects, particularly if the quantity and quality of the geothermal water resources identified by the drillings shows up to be well below the expected levels. The most suitable markets for GE are where district heating applications – including horticulture and fish farming – are situated near by the reservoirs and plants. The use of geothermal *Cascade Systems* may further improve the economic efficiency of geothermal plants.

The existence and availability of national co-funding mechanisms helps to attract international project financing. However, small projects, ranging typically between USD 1 and 5 million, are often very difficult to obtain funding for since they are currently considered to be too big for local financing only and too small for major IFIs and donors to get involved.

CEEC stakeholders generally considered IFIs to be bureaucratic to co-operate with, and the process of obtaining IFI loans/grants is deemed to be extremely time consuming and a rather complex task. In this context, DEPA funding is praised for being much more flexible and "user-friendly".

Relative low cost of fossil fuels in general, and natural gas in particular, means that currently only the "best" geothermal resources can compete economically with existing, conventional, energy sources. The loss of hydrocarbon reserves and the emission of CO_2 from burning of gas and/or other hydrocarbons, is not a prioritised environmental problem in all CEECs and, consequently, clear economic incentives for GE are lacking. In such CEECs it may be difficult to obtain significant private/national financial support for geothermal plants and international funding (donors, IFIs) is therefore needed in order to demonstrate opportunities for cost efficient CO_2 reductions from geothermal plants.

2.2.3 Institutional and Policy Lessons Learned

National CEEC policies generally have not been much concerned about realising national GE potentials. Regions with proven geothermal resources, however, often demonstrate strong political interest in favour of GE. It is therefore deemed essential that local and regional levels will be involved early

in the project process through financial and political responsibility and commitment by local authorities, institutions and consumers. The establishment of *geothermal shareholder companies* has shown to be an effective way to obtain project commitment and sustainability.

It is important to clarify *institutional structures and ownership rights* prior to project implementation between state, regional/local authorities and private companies to minimize risk for disputes and disagreements after the project has begun. In the field of environmental protection and renewable (geothermal) energy, responsibilities often overlap between Ministries and public institutions in the recipient country.

DEPA (DANCEE), and the Danish experts contracted, is well regarded in the CEECs, - as well as among local stakeholders and other international geothermal "players"- , due to previous involvement in geothermal project activities. In this regard, the Danish support on *project management/organizational issues* is considered essential in creating sustainable local capacity, but also in securing smooth project implementation on all levels. Additional focus is however required on how to establish a supportive relation between the local project office (project plant) and foreign firm(s) contracted for project management/organizational support.

2.2.4 Environmental and Technical Lessons Learned

Not all of the DEPA-funded geothermal projects are fully operational yet, but significant reduction in emissions of SO_2, particles, and CO_2 in particular has nevertheless already been obtained. Geothermal projects have therefore so far shown to be good investments from an environmental point of view.

On the technical side, it has been found that problems related to drilling and project equipment can delay project implementation significantly. In the case of demonstration projects, this can seriously affect local confidence in GE. Moreover, it is of crucial importance that geothermal plants will be dimensioned on the basis of expected *future* energy demand, taking possible implementation of energy efficiency and energy saving measures into consideration. Some geothermal plants today operate with excess capacity because they were dimensioned based on base-line rather than prospected energy demand.

Inputs from Danish sector experts have been an important factor in achieving successful geothermal project results so far. However, it must also be recognized that the CEECs have demonstrated high and increasing capacity to support project planning and implementation. It has also been found that comprehensive geological data for geothermal energy development is available in the CEECs, and much technical research has been done.

2.3 Other Project Experiences

In addition to the DEPA projects, two other geothermal projects in the CEECs involving other sources of financing were visited and assessed in this study, namely the Galantaterm (Slovakia) project and the Mszczonów (Poland) project.

The Galantaterm case study demonstrates that exploiting GE in Slovakia is indeed feasible, given the proper conditions. But Galantaterm does suffer a poor socio-economic condition and development affecting the Slovakian energy sector in general. This includes a situation where local consumers are currently not willing, - or able - , to pay their heating bills.

The Mszczonów project has demonstrated important lessons with regards to the use of closed wells, and how to obtain local project financing and anchoring for small scale geothermal projects in Poland. Regional socio-economic conditions as well as national energy price policy has however affected the economic fundament of the project to some degree. But as for other CEECs, do the prospects of EU integration and further market liberalizing give promise of positive perspectives for future relative energy prices.

2.4 Best Practice Project Design

Following the experiences from the 8 geothermal projects assessed by this study, a best practice or ideal project design can be developed for geothermal project implementation in the CEECs (see below). The list of components should not be considered exclusive and other criteria might be relevant as well, depending on the specific project context. However, the criteria included in the categories below represent a minimum set of criteria to be applied.

Best Practice Project Design

- *Economic Issues:*
  - National energy prices are liberalized, - or clearly in the process of being so.
  - Co-funding is available, - nationally and/or internationally.
  - A market for heat exists and is accessible, and up-dated market surveys are available.
  - Local, financial project commitment is in place.
  - Feasibility studies have been or are being prepared.
  - State guarantees are provided.
  - State funding programme(s)/mechanisms in support of renewable (geothermal) energy development are approved and in operation.
  - Soft/low interest project loans can be obtained through national banks.
  - Environmental and other hidden costs are explicitly accounted for in project proposals, - including costs relating to alternative projects based on conventional energy.

- *Institutional Issues:*
  - National legislation is in place and support GE development.
  - National legislation and regulations on (foreign) investment and trade are generally in support of GE development.
  - Clear policies and strategies in support of renewable (geothermal) energy are in operation, or are to be implemented shortly (nationally/regionally).
  - A suitable project management set-up is proposed.
  - Project ownership is clearly defined.
  - Capacity for project implementation exists at all critical levels, or can be created without major difficulties.
  - GE is accepted and supported locally as an alternative energy source.

- Decentralization of responsibilities from state to the regions is in place, - in particular concerning energy and environmental issues.
- Information channels between regions and government are well established.
- Clear division of responsibilities of GE issues between ministries and public institutions as well as between national/regional/local political levels. Preferably, there is only one institution/organization responsible for project preparation/implementation in the recipient country.

- *Technical Issues:*
  - A heat distribution network is in place and of a good quality.
  - Boreholes are available and functioning, - or:
  - Good quality geothermal data is available, reducing risks for making futile boreholes.
  - Water temperature should be high, - preferably above 45° C.
  - Reservoir type and size is adequate to the expected market demand.
  - Flow rate and TDS are acceptable.
  - Local technical capacity is adequate for management and implementation of GE projects.
  - Up-dated heat demand analysis and prognoses are available.

- *Environmental Issues:*
  - Significant environmental impacts locally/regionally and nationally/globally, due to substitution away from polluting energy sources (coal, fuel oil) plus efficient distribution and use, have been foreseen.
  - Implementation of national policies in recipient countries is devoted to reduction of greenhouse gasses and other pollutants.
  - Geothermal systems are in accordance with local/regional principles of sustainability.
  - There is co-ordination with other energy/environmental projects/programmes in order to increase environmental impacts of investments.

The specific contents of the preconditions depends on the project context and should be qualified in accordance with this.

After this summation of the outcome of the retrospective analysis, the next chapter will focus on the prospects for future geothermal project implementation in the five DANCEE focus countries (Russia, Poland, Romania, Ukraine and Slovakia).

3 The Prospective Analysis

3.1 Geothermal Energy in the CEECs – Towards a Renaissance

Today, indications are that GE for heating in the CEECs may be facing a renaissance. The reasons for this are many, and some of the central factors are listed below in Box 3.1-1.

Box 3.1-1 Factors In Favour of a Geothermal Energy Renaissance

- New international environmental treaties.
- New technological developments.
- Greater awareness and acceptance of GE by political decision makers.
- The enlargement process of the European Union.
- GE is a reliable and safe local energy resource reducing especially SO_2, CO_2 and other harmful emissions.
- GE may reduce a region's need for imported fuels.
- GE is a renewable source of energy reducing the need for fossil fuels.
- Geothermal plants operate continuously compared to for e.g. wind and solar sources.
- GE has an inherent storage capacity and thus does not require storage and transportation of fuels.
- Several CEECs have a long tradition for direct use of GE, mainly for recreational purposes.
- In the CEECs, district heating networks and boreholes exist in many places, thus lowering the potential GE investment needs.

Below, a comparative assessment of the analysis of the five DANCEE focus countries is presented. The analysis includes the capacity and potential for geothermal project implementation and compares technical, environmental, institutional and economic components related to geothermal energy development within these countries.

3.2 Geothermal Energy Potentials in the CEECs – A Comparative Analysis

3.2.1 Economic Potential

The main barrier for geothermal project implementation in all five focus countries is the lack of funds. However, the point of departure differs between

countries. The Polish and Slovak economies are relatively more economically and politically "advanced", and these countries currently represent safer opportunities to potential investors than, say, Russia, Ukraine or Romania do.

Poland and Slovakia are soon facing EU accession and have through the last decade profited from strong economic support from EU countries and international financial institutions, which in turn has created advantageous conditions for economic growth and restructuring of the country. While full and final integration with the EU Energy & Environmental Chapter is still pending, major steps towards liberalization of energy pricing have brought price levels closer to EU levels.

GE development has now proven to be economically feasible under present conditions in both Poland and Slovakia. This has attracted more interest from municipalities as well as from private investors to take part in geothermal projects in these countries. Where new drillings are needed, obtaining funds to finance the first drilling remains a critical barrier though, since this is always related to certain risks regarding the quantity and quality of the geothermal water.

In view of this, it is crucial for future geothermal development that some kind of indemnity system is defined and implemented in order to attract required private and/or national project capital. The fact that financial support from IFIs and bilateral donors to Poland is now decreasing, as a consequence of the country's increasing economic ability to act independently, further strengthens the importance of this issue.

The economies of both Russia, Romania and Ukraine experienced serious difficulties throughout the 1990's and the transition process in these countries has been and, to some extent, still is a difficult task. The main challenges regard economic recovery and establishing transparent rules and regulations, also within the environmental and energy sector. The countries have now passed a great deal of critical hurdles though, and are receiving increasing financial support from the EU and the international financial institutions.

Energy prices in the CEECs have increased substantially over the last few years. Nonetheless are price subsidies, in-transparent mechanisms for price calculation and neglect of negative environmental externalities still characteristic for energy pricing within all countries in question. This, in turn, is greatly favouring some (polluting) energy sources over renewable, environmentally friendly energy sources such as geothermal. A particular sensitive issue in Ukraine and Romania, and to some extent also in Poland, is related to coal price subsidies: Coal has a particular socio-economic importance in these countries, which makes it exceedingly difficult for the governments to eliminate existing coal subsidies.

While Russia, Ukraine, Slovakia and Romania do not have any efficient national funding mechanism in operation to support geothermal project development, in Poland there are two funds: Eco Fund and National Fund for Environmental Protection. These two funds have both contributed with significant funding for the geothermal projects implemented in Poland so far. Moreover, the contributions from the Polish national funds have become important factors in attracting international funding for the projects. It is therefore considered a strong positive attribute for Poland to have these funds in operation.

Ukraine has an "ecological tax" on electricity consumption, where the tax revenue is dedicated to wind power development. In case GE will be able to demonstrate its profitability in Ukraine, this eco-tax modality may well be extended to include geothermal industry. Russia is well advanced in making operational and – together with the Energy Carbon Fund - institutionalise the concepts of joint implementation and carbon credits. As for committing to renewable energy, noteworthy allocations have been made in the federal budget in august 2001 for renewable energy initiatives in South European Russia.

While in Poland, loans for geothermal projects can be provided with subsidized interest rates, this is not the case in any of the other four focus countries. High interest rates and short repayment terms therefore significantly impede large scale project implementation in these countries. This is, again, directly related to the fact that geothermal investments in these countries are still considered a highly risky business, which requires a high "risk premium".

Another element to be considered is the variation in socio-economic conditions between countries and regions. Even within the same country, socio-economic conditions may differ considerably and may present very distinctive contexts for implementation of geothermal projects. In Poland, for instance, it is obvious that the richer, southern part of the country represents a different GE outlook than other regions. The same picture was also seen in Russia and Ukraine, countries which both contain varied, dispersed regions with high geothermal potentials.

3.2.2 Institutional and Policy Potential

A general feature of all five focus countries is that responsibility for geothermal energy development is divided between different ministries and public institutions, thereby making it difficult to identify a coherent, national approach. Although different support programmes exist, mostly related to scientific work, it is also characteristic that none of the five focus countries have a clear and operational policy on renewable energy, including geothermal.

Even though comprehensive reforms have been undertaken within the energy sectors during the transition period, GE has to a large extent been neglected in this process. Most countries have developed medium and long term "strategies" for renewable energy, indicating goals and potentials. These strategies, however, do in general not include much description on how to achieve these goals and little concrete, crucial information on how to finance related activities and projects.

In order to pave the road for future geothermal development in these countries, it will therefore be necessary to complement these very general strategies with concrete, realistic and operational action plans with particular focus on GE. The development of such plans ("Business Plans") should address issues of institutional, financial and socio-economic character, all elements that are of utmost importance to project sustainability and impact. Such issues are often omitted from existing technical geothermal (feasibility) studies. The existence of comprehensive plans would be a major tool for

future, sustainable advance within the geothermal field and would naturally integrate the need for stronger coordination of donor funding and loans.

Another important and related feature identified within the institutional context is the division of responsibility between the national (governmental) level and the regional/local level. The current tendency in all countries is to delegate more autonomy to decentralized levels, including issues of energy and environmental concern. However, these political intentions are generally not followed by sufficient increases in transfer of resources (human and/or economic) from the state. Moreover, it does seem to be the case particularly within the energy sector that the state wants to maintain influence and consequently only delegate limited responsibility and autonomy. These circumstances add to paint a picture of a very complex institutional environment within these CEECs. Geothermal energy development is certainly affected by this situation and it must therefore be considered a high priority to clarify and map these issues, including ownership rights, as part of a general approach to improve the institutional environment for geothermal investments.

In Romania, Ukraine and, to some extent, in Russia, GE projects still need to prove their profitability before it can be expected that significant national (private/public) capital will be allocated to such projects. This is mainly due to two factors: Firstly, due to scarce resources in the national budgets, not much funding is channelled to environmental/renewable energy purposes unless there is a very clear indication of "good business". Secondly, even though much reforming has already taken place within the political environments in these countries, real transparency and sound political decision making is still gradually being built up in some areas. This is the case for the energy sector, where the oil and gas business (import/export) traditionally has been considered an attractive business for some politically influential groups in these countries. It is therefore difficult to change the existing energy structures over night. Again, what will be of crucial importance to geothermal energy development in these countries is to show good demonstration projects governed by realistic business plans.

Although no particular geothermal legislation exists, laws on concession rights for underground resources are now applicable for geothermal resources in all countries. In Romania, the Mineral Law from 1997 represents a major progress in this field, since it opened up the possibility of obtaining license for up to 20 years. Earlier it was only one year and thereby a serious problem in relation to attracting private investment capital for geothermal projects. Ukraine has also recently modified their legislation regarding concession rights, which makes it more attractive for private companies to invest in GE projects.

From a Western perspective though, institutional shortcomings in the countries in question, like legal enforcement gabs, lack of information sharing and market institutions (enforceable contracting and property rights) represent an important barrier for large scale foreign investment. This does particularly apply for Russia, Ukraine and Romania. Joint ventures may in this context be an attractive way for prospective investors to overcome such institutional insufficiencies.

3.2.3 Technical Potential

Data material and significant research work on GE already exists in all focus countries. Moreover, relevant human resource capacity is available to support future geothermal development. Within all countries there are small scientific groups of geothermal specialists with several years of experience, but it is also characteristic that young geothermal scientists are currently being educated through special courses on the universities and practical work experience.

In Russia, Ukraine and Slovakia the scientific capacity and the centre for geothermal research are placed in the capitals, far from the most potential project sites. All three countries are characterized by having not only one, but several very promising geothermal regions. In Romania by contrast, the geothermal research centre is placed in the city of Oradea in the area, which is by far the most promising from a GE point of view. The geothermal research centre in Poland is in the Podhale region (Southern Poland), where the main GE project activities also are ongoing. The presence of geothermal scientific expertise and activities close to project sites is a positive factor in relation to project sustainability and local support.

In all five focus countries, several boreholes already exist, drilled in the past for gas and oil purposes. These wells may be used for GE purposes also, and one such project has successfully been implemented in Poland (Mszczonów, see case study, Volume II). More such projects building on existing drillings are anticipated in Poland and this concept could potentially also be developed further in Romania, Slovakia, Ukraine and Russia. However, in some areas it does seem to be more problematic to include existing wells for GE purposes, since many of them are not placed close to towns with heating networks. It is an important economic and logistic advantage if district heating networks already exist, but as the existing district heating infrastructure is often in very bad condition, requiring new investments, this matter is not straight-forward.

3.2.4 Environmental Potential

Even though some improvements have taken place with regard to environmental legislation and energy policy, as well as in CO_2 emission levels, all five focus countries continue to have serious environmental problems directly related to the use of polluting energy sources.

The district heating sector emits a significant part of CO_2 emissions, and the sector is stuck in a vicious circle: Despite price increases, which were meant to increase income for the owners, the existing networks are often in such poor condition that the owners (often municipalities) still do not have sufficient economic funds to improve the systems. Consequently, there is a tendency for frustrated consumers to disconnect from the district heating systems, since they are not getting better service, but are expected to pay more. Such disconnections lead to higher prices for the remaining costumers - thus the vicious circle. The increasing inefficiency of the heating systems is reflected in falling energy efficiency throughout the 1990's in all focus countries, except from Poland.

Geothermal heating plants represent an opportunity to break this vicious circle. GE is an attractive vehicle for improvements in the energy system, because each project brings with it opportunities to take a holistic or system view of the district heating system, in which the project is to be integrated. In

this process, new technologies, insulation materials and standards can be introduced, potentially leading to systemic change, saving energy and increasing efficiency beyond the geothermal unit.

As a positive remark, it should be noted that all countries in question now require assessments of the environmental impact of geothermal projects, as well as for other energy projects, prior to project approval.

3.2.5 Overall Assessment

To sum up the comparative analysis, Table 3.2-1 gives an overview of the potentials for each of the five focus countries within different categories. It should be noted that each category contains a range of factors. *Technical potential,* for instance, includes geothermal resources as well as human capacity, and is as such a weighted mix of all these factors.

As it can be seen from Table 3.2-1, the *technical potential* is considered to be very high for all countries in this study. This is an important point of departure since the technical potential will be the first thing to look for in order to consider geothermal project implementation within the CEECs.

It should also be noted that the environmental potential is considered to be high in all countries, with some variation in scale between the countries. Based on the current situation and future outlook, Ukraine is considered to present a case of significant potential environmental benefits while Slovakia already has a much more energy efficient structure in place and therefore, at the aggregated level, presents less environmental potential.

The *economic potential* varies more between the countries and does in a certain degree reflect the countries' current capacity to present an attractive climate for geothermal project investments, including through national funding mechanisms and programmes.

The *institutional/policy potential* refers to central issues such as the degree to which countries are currently institutionally organized and structured to support national geothermal development. As it is the case with economic potential, the institutional/policy conditions also vary considerably, reflecting mostly different stages of the transition and EU approximation process.

TABLE 3.2-1 GEOTHERMAL POTENTIALS

	Economic Potential	*Institutional/policy Potential*	*Technical Potential*	*Environmental Potential*
Poland	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓✓
Russia	✓✓	✓✓✓	✓✓✓✓✓	✓✓✓✓
Romania	✓✓	✓✓✓	✓✓✓✓✓	✓✓✓✓
Slovakia	✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓
Ukraine	✓✓	✓✓	✓✓✓✓✓	✓✓✓✓✓

(✓✓✓✓✓ = MAXIMUM SCORE; ✓ = MINIMUM SCORE)

In conclusion, it shall be emphasized that all five countries represent interesting cases for geothermal project implementation. From a *technical* and

environmental point of view, it is evident that all countries have clear potentials. The general lower scores on the *economic* and *institutional/policy* components should be interpreted in the way that the five countries, at this point of time, need additional support on these issues in order to make geothermal project development sustainable. Moreover, even though the four components have been treated separately here, they should in practice always be integrated in order to obtain a holistic judgment of project effectiveness, impact and sustainability.

Finally, an important factor, which is not integrated into the above assessment, is the *demonstration effect* of geothermal projects. In Poland and Slovakia, and to some extent in Russia, GE plants and their potentials are now well-known. Conversely, in countries such as Ukraine and Romania, the demonstration effect from GE projects is a crucial parameter that should be taken into consideration when assessing potential project proposals.

4 Towards Strategic Development of Geothermal Energy Potentials in the CEECs

This study has identified barriers and risks, as well as opportunities and drivers, for promoting geothermal energy projects in CEECs. It has also identified the need to focus on characteristics, advantages and disadvantages of politics and funding sources, donors and investors, within the CEECs.

From the *Retrospective Analysis*, and from the geothermal projects visited during this study, it was clearly demonstrated that geothermal energy systems indeed represent an interesting and promising opportunity for future energy supply to Central and Eastern European countries and regions. A list of valuable lessons learned has been extracted from the geothermal projects implemented so far. This experience has been mapped out through this study and represents an efficient guiding tool for future selection of geothermal projects for financing.

From the *Prospective Analysis,* it was concluded that all five DANCEE focus countries (Poland, Russia, Romania, Slovakia and Ukraine) have strong geothermal potentials. The *technical* and *environmental* potentials were deemed to be high in all countries in question. With respect to *socio-economic* and *institutional/policy* issues, however, the point of departure differed between countries and regions. Since these latter issues are of crucial importance in order to attract investors and demonstrate project sustainability, it is considered essential that future geothermal project implementation in the CEECs will be based on not only technical and financial parameters, but also on thorough analysis of socio-economic and institutional conditions of relevance to the project.

Inputs from Danish sector experts have been an important factor in achieving successful geothermal project results so far. Moreover, DEPA (DANCEE), and the Danish experts contracted, is well regarded in the CEECs as well as among local stakeholders and other international geothermal players. It is of paramount importance to acknowledge that the reason why Denmark and the Danish Ministry of Environment has a high international comparative advantage in achieving sustainable (environmental) results in the renewable energy sector, is the *system character* of the Danish energy related products. It is systemic in the sense that the institutional underpinning and context is often exported along with the products, thus contributing to create positive institutional change and more conducive environments for renewable energy in the recipient countries. An example of this is when a geothermal project introduces not only components that improve the insulation of the district piping network, but the institutional components of the project also help to create institutional improvements at regional and national level.

From this assessment, questions may be raised on how international donors, bilateral agencies and international finance organisations may best help to promote Geothermal Energy in the CEECs, in cooperation with the national

and regional partners and institutions. A range of different international players are today involved in geothermal project activities in the CEECs and others might have both interest in and potential to get involved. In the past DEPA, through the DANCEE programme, has worked with international financial institutions as well as with Nordic and national lending institutions. Most of the support from the international society has, however, so far been given on an individual and uncoordinated basis, thus leaving a clear need for more coordination and cooperation within the field of geothermal energy development.

Main international players currently involved in geothermal project activities in the CEECs include the World Bank, EU, EBRD, EIB, NEFCO/NIB, GEF /UNEP and GIA.

4.1 DEPA as an International Player Promoting Geothermal Energy

Owing to the experiences from the DANCEE programme, the Danish Ministry of Environment is in a good position to continue and intensify its pivotal role as a promoter and disseminator of renewable energy sources like GE in CEECs.

By commissioning a strategic study on GE, hosting an international workshop on the future of GE in the CEECs and finally preparing a strategic action plan, DEPA has contributed to achieving a high level of international coordination and collaboration in promoting GE in these countries.

This strategic study provides DEPA with an instrument by which to steer, govern and channel future investments in, and selections of, geothermal projects. Consequently, future geothermal projects to be supported by DEPA should be selected according to a set of economic, institutional, technical and environmental criteria (see 2.4). These criteria will address prevailing political, institutional and regulatory conditions, including policy initiatives and programmes to promote GE.

This study confirms that a new market is indeed developing, offering commercial opportunities for pioneer companies. The market, however, is by nature dependent on governments and international organizations cooperating to establish a stable and solid framework for private investments. The involvement of industrialised countries in the GE sector in CEECs is both necessary and desirable for this sector in order to develop its full potential.

4.2 Towards Concerted Action – Actions to be taken by DEPA

Through this study, it has been documented that a range of issues will need to be addressed in order to create conditions for a real "take off" for future development of geothermal energy potentials in the CEECs. Core challenges include the following issues:

- Strengthening of mechanisms and fora for international collaboration on support to geothermal energy development in the CEECs.

- Ensuring that future GE demonstration projects in the CEECs will be based on not only technical, but also thorough economic, institutional

and policy analysis in order to ensure sustainability of these project activities.

- Creation of attractive economic conditions and climate for GE investments in the CEECs, also for smaller projects, for national as well as for potential international investors.

- Better linking and coordination of geothermal projects with other energy and environmentally related projects within the CEEC regions.

- Improvement of institutional and regulatory support mechanisms within the CEECs for GE project development.

- Stronger involvement and commitment from CEECs in GE project development, involving both national and regional levels.

- Improvement of promotion, advocacy and information systems for geothermal project development in, and between, the CEECs.

Based on the analysis and experience provided by this study, a list of concrete and strategic DEPA action proposals has been developed, taking into consideration comparative advantages and the complementary role of the DANCEE programme. The initiatives proposed should be considered with a view to common action involving international as well as national key players related to geothermal energy development in the CEECs.

It is recommended that DEPA, through the DANCEE programme, will:

- Take active part in, and collaborate more closely with, relevant international (European) fora promoting geothermal energy development. For instance, the GIA represents a good opportunity for Denmark to be on the forefront of, and influence, the future development within the field of GE.

- Consider taking a supportive role in the creation of an insurance system for GE in all CEECs. Either on a commercial basis in the form of a revolving fund, or a consortium model. Overcoming the barrier of "first step risk" remains a key to development of the geothermal sector, and creating an institution to cope with this risk is therefore paramount to creating a take-off situation for GE.

- Contribute to the creation of European consortia and joint ventures by giving priority to projects with co-financing from European industrial partners, e.g. through the use of advance/reimbursable project identification and pre-feasibility studies.

- Seek closer collaboration between bilateral donors and International Financial Institutions (including Nordic and Danish lending institutions) providing low interest loans for GE, based on thorough analysis of the comparative advantages and complementary roles of the different agencies involved in financing and supporting development of GE.

- More systematic coordination of geothermal project activities with other relevant (Danish) energy/environmental projects/programmes in

the CEEC in question. This should be done in order to achieve both maximal environmental/energy effects from the (Danish) funds, but also in order to involve other potential (Danish) investors and funds that may have an interest in the geothermal and district heating areas.

- In policy dialogues with partner countries, promote the idea of creating a favourable investment climate for GE through e.g. tax reductions for renewable energy products, tax incentives for GE investments, soft loans and financial incentives for end users of RE/GE sources.

- Concentrate relatively more attention on management, institutional, policy and socio-economic issues in relation to geothermal project implementation. Neglect of these factors have in the past created unsound situations, even for projects with strong technical potential.

- Consider how decentralizing and regional development could be better linked to geothermal projects, since geothermal potentials are often more of regional than of national concern in the CEECs. This could create the basis for large scale geothermal development at regional levels through development of comprehensive and coherent regional business plans, addressing relevant issues of technical, institutional/political, environmental, as well as of financial nature.

- Support development of mechanisms that can ensure transfer of "best practices" from geothermal development activities in one CEEC to other countries in the region. Best practice could be either project specific or related to national/regional policy issues. It could be transferred in the form of project visits, workshops, seminars etc.

- Intend to link implementation of geothermal projects closely to solving other energy related problems in the CEEC regions, such as energy inefficiency. Of particular importance is that geothermal plants will not be dimensioned from current heat consumption but from realistic expectations to future heat demand.

- Continue technical and financial support for GE demonstration projects in countries where geothermal potentials are substantial but undeveloped. Project implementation, however, should be based on comprehensive analysis of not only technical, but also economic, institutional and policy issues in order to minimize risks and ensure sustainability of project activities.

- Consider how to create efficient funding mechanisms to support implementation of smaller geothermal investments projects. This could be in the form of institutional support to regional authorities in areas with significant geothermal potential and where multiple geothermal projects are feasible.

- Support the CEECs in creating adequate institutional and regulatory infrastructure for geothermal project development (national level) and to implement plans and projects (regional and local level).

- Support creation of a Central and Eastern European GEO-Heat information centre, located on a geothermal heated campus. Such a

centre has been in operation for 25 years in the US, providing information, data, publications, tours, lectures, training and user guides, and could indeed be a useful platform for further promotion of GE in the CEECs.

- Support promotion and media presentations in the CEECs on GE in general and its potential for replacing coal and other hydrocarbons in particular.

- Support an annual update of a "GE Best Practice Assessment" to be distributed and used worldwide to strengthen the platform for geothermal project implementation. (The best practice from this GESA study could serve as a point of departure for a first update).

- In general, nurture the international enthusiasm and optimism identified in this study for the future of GE development in the CEECs by appropriate initiatives and action.

It should be emphasized that although the above listed proposals for action focus on DEPAs complementary role and advantages within the international context, DEPA should not await actions taken by IFIs and/or other donors, but should be willing to act on its own and take appropriate actions to support the future development of GE in the CEECs.

5 Concluding Remarks

Through this comprehensive assessment of geothermal energy potentials in the CEECs, a number of factors and challenges of relevance to future development have been identified and analysed. It is obvious from the outcome of this study that geothermal energy development is currently underestimated in relation to national energy policy reforms and planning in the CEECs. In order to promote geothermal energy development in the CEECs, more focus on the creation of incentives and frameworks for this particular energy source is therefore needed.

It has been confirmed that the *technical and environmental potentials* of geothermal energy systems are e*xtensive* in Central and Eastern Europe. Considerable reservoirs of high-quality hot water exist in the underground of most of the CEECs examined in this study, and calculations and studies of environmental accounts demonstrate significant positive effects from geothermal energy plants. Major geo-political forces and environmental policy developments are expected to increase the tendency to internalise more and more environmental accounts directly into the economic system(s) that governs both economic decision makers and the "invisible" hand of the markets.

From an *economic* point of view - and considering that the CEECs still are transitional economies - the ongoing process of changes in all focus countries was found to improve future conditions for geothermal energy development. However, it was also found that the CEECs demonstrate rather different levels of preparation towards making GE an attractive "economic business". In some countries, donor funding will be required to demonstrate efficient geothermal project models, whereas in other CEECs, focus should be directed more towards how to attract private/national investors. The relative imperfection of insurance systems to cover geological risks is one important factor impeding inflow of private capital into geothermal projects.

From a *political and institutional* point of view, this report has identified the major challenges to the future of GE in the CEECs. Both politically and institutionally, there is a certain amount of inertia in most of the countries investigated. GE faces established interest groups and mindsets. It also faces existing infrastructures, legislation and other rules and patterns that are not always conducive to the development of the GE sector. These challenges have been listed throughout this report and are addressed by the strategy outlined and proposed.

The geothermal projects evaluated have been launched on an individual basis as separate projects initiated from a bottom-up approach. The experiences so far from these projects have been translated into a list of *lessons learned,* which are presented throughout this report. Eventually, these lessons were converted into a set of *best practice* criteria to be used as a base for future selection of geothermal projects for financing within the CEECs.

Know-how and technologies built into the Danish district heating systems, and the institutional environment surrounding it, serve to make the Danish

low-temperature district heating systems highly relevant for export in relation to geothermal projects in the CEECs. The effort and experiences generated by Danish geothermal experts have proved very useful in several CEECs, where geothermal energy sources have been integrated into district heating systems.

One of the major outcomes of this study is that in order to achieve most value and environmental impact for the DEPA funds in the CEECs, geothermal energy projects should in the future be considered as more than just isolated projects. Indeed, a much more comprehensive approach is needed, both in relation to the CEECs, but also taking into consideration the various existing and potential actors and their comparative strengths and weaknesses.

The timing of this geothermal study has been excellent. The fact that for most CEECs the period of transition is gradually nearing completion, and that integration into the European Union is within sight, offers new perspectives. In this context, promotion of geothermal energy at a wider scale presents new opportunities, but indeed also a range of challenges, which must be faced and handled by all actors involved.

Another, and more unpredictable, result of this study and its timing has been the great and active interest from international as well as Danish actors within the geothermal field in following the study from the sideline and contributing to the discussions and development of operational action proposals in favour of geothermal development in the CEECs.

The increasing international attention on the potentials of geothermal energy was documented at the International Workshop on "The Future of Geothermal Energy in the CEECs", carried out on October 8th and 9th 2001 in Copenhagen, as part of this study. The workshop was attended by representatives from international financial institutions involved in geothermal project activities, such as the EBRD, EIB and NEFCO/NIB, and by other international geothermal organizations and programmes like the UNEP/GEF Network and the Geothermal Implementing Agreement (GIA). From Denmark representatives from DEPA, DEA, Danish Investment Funds and private companies assisted at the workshop.

The workshop also paved the way for further concerted action and contact between both international and national geothermal actors. The workshop indeed confirmed that DEPA, due to its flexibility and experience so far, can become a main player in creating a future "take-off" for geothermal energy development in the CEECs.

This study has documented that sustainable development of geothermal energy projects in the CEECs will not only require a better mix of financial and technical assistance inputs. It will also require that the institutional and policy framework will be prepared to support such inputs. Moreover, with an adequate institutional framework in place, foreign investments will be encouraged and GE projects may be implemented easier and faster than before.

When compared to the IFIs, a major reason why DEPA has a pivotal role in promoting geothermal energy is the "scaling problem". This problem is evident when, for instance, the European Investment Bank and the World Bank voice its preference for "large" projects. This situation creates a need for

someone to fit project and promoters and help "tailor" projects, including packets of finance. Maximising the additionality of DEPA in comparison to IFIs and bilateral donor organisations is an important objective in this process.

With this report, DEPA moves towards a strategic process designed to optimise the environmental impact and benefits for DEPA funds. As outlined in this study, coherent and integrated support to geothermal energy development in the CEECs presents highly positive and promising potentials for environmental investments. Through a strengthening of its central position within the geothermal field, DEPA will therefore contribute significantly to achieve the objectives of the DANCEE programme, within an area where Danish experts and companies possess relevant competencies and experiences.

FURTHER INFORMATION ON THE DANISH ENVIRONMENTAL ASSISTANCE TO EASTERN EUROPE:

DANCEE releases successively various types of publications on the Danish environmental aid to Eastern Europe. Each type has its own colour.

DANCEE STRATEGY

"Danish Strategy for Environmental Assistance to Eastern Europe 2001-2006"
Describes DANCEE's general strategy up to year 2006. Danish and English. For free.

ANNUAL REPORT

Contains a description of all projects launched and initiatives taken in connection with the Danish environmental assistance to Eastern Europe for the actual year. For free.

COUNTRY PROGRAMME

DANCEE's strategy and priorities in the individual recipient countries are described. Country programmes are planned in co-operation with the recipient country. English and the recipient country's language. For free.

COUNTRY BOOK

The country book describes the Danish environmental aid in each recipient country. It contains among others, description of the aid's progress and the environmental effects. It reviews typical projects within the different field sectors. English and recipient country's language. For free.

COUNTRY PAMPHLET

A brief and popular version of the country book which, with focus on concrete projects, explains the Danish environmental aid to the recipient country. English and recipient country's language. For free.

THEMATIC REPORT

Technically orientated report dealing with subjects of specific importance to the environmental aid, e.g. wastewater treatment or control instruments. Danish and English.

PROJECT PAMPHLET

Describes a specific environmental project and is released typically in connection with the opening of the project. English and recipient country's language. For free.

The publications are available at:
Milljøbutikken (The Danish Ministry of the Environment outlet)
Læderstræde 1-3
1201 Kbh K
Tel.: 33 95 40 00
Fax: 33 92 76 90
DANCEE on the Internet: www.mst.dk/dancee

The Danish Strategy for Environmental Assistance to Eastern Europe 2001-2006 defines the Danish policy for environmental assistance to Eastern Europe until the year 2006. The strategy describes objectives and prioritised areas of action for the Danish environmental assistance.

DANCEE PUBLICATIONS:

- PROJECT PAMPHLET
- COUNTRY PAMPHLET
- COUNTRY BOOK
- COUNTRY PROGRAMME
- ANNUAL REPORT
- DANCEE STRATEGY
- THEMATIC REPORT

DANCEE
Danish Cooperation for
Environment in Eastern Europe

Miljøstyrelsen
Strandgade 29
DK-1401 Copenhagen K
T: +45 32 66 01 00
www.mst.dk

Ministry of the Environment