CASE STUDIES (and lessons learned)

Education

3.7.
BUILDING UP PROFESSIONAL MAN POWER FOR CEE - Contribution of the UNU Geothermal Training Programme

I.B. Fridleifsson (*ibf@os.is*) and L.S. Georgsson (*lsg@os.is*)

United Nations University Geothermal Training Programme
Orkustofnun, Grensasvegur 9, IS-108 Reykjavik, Iceland

Abstract

Some use is made of geothermal energy in over thirty countries in Europe. Half of these are in Central and Eastern Europe (CEE). Despite their long tradition in the direct application of geothermal water in health spas and horticulture, the CEE countries have in many aspects been isolated and lagging behind in geothermal technology. Until the 1990´s, the opportunities for professionals in CEE countries for geothermal training were fairly restricted. A review is made on the availability of geothermal training and on the number of participants from CEE countries attending three months or longer training at the four main international geothermal schools established in the 1970´s (in Iceland, Italy, Japan, and New Zealand). A description is given of the UNU Geothermal Training Programme (UNU-GTP) in Iceland, which after closure of the other three is the only international graduate school offering specialized training in all the main fields of geothermal science and engineering. A summary is made on the contribution of the UNU-GTP to professional capacity building in geothermal energy in the CEE countries. Finally, some ideas are suggested on possible next steps in geothermal training for the benefit of the CEE countries.

Introduction

The pioneering countries of geothermal development (e.g. Hungary, Iceland, Italy, Japan, New Zealand, and the USA) started developing their geothermal resources basically from scratch (Fridleifsson,1995). Engineers, geologists, chemists, and physicists combined forces within each country. The first groups of geothermal specialists were commonly built at government agencies such as the USGS (USA), DSIR (New Zealand), and the State Electricity Authority (later named Orkustofnun, Iceland). Much experience was drawn from established disciplines such as groundwater hydrology, mineral exploration, oil exploration, oil production etc. Many key people in the early days of geothermal development first met at the United Nations Conference on New Sources of Energy in Rome in 1961. That meeting was a milestone in international cooperation in geothermal energy research and development.

It has long been recognized that the development of geothermal resources requires a dedicated group of highly skilled specialists from many disciplines of science and engineering. Because of its diversity, geothermal energy research is not taught as a separate subject at universities, but is a field where specialized theoretical work and practical training is required at post-graduate level. The training of geothermal specialists has mainly taken place on-the-job within companies and institutions. But especially for the benefits of the developing countries, international geothermal schools have contributed significantly in the transfer of geothermal technology from the leading geothermal countries to newcomers in the field.

International geothermal schools

The first international geothermal schools were established in 1970 in Italy (the International School of Geothermics in Pisa), and in Japan (the International Group Training Course on Geothermal Energy at Kyushu University). Both were supported by UNESCO and the respective governments. The support from UNESCO, however, soon became a token amount only. After international deliberations on the increasing need for geothermal education in view of the oil crisis, two new geothermal schools were established in 1978, in New Zealand (the Geothermal Institute at the University

of Auckland) and in Iceland (the United Nations University (UNU) Geothermal Training Programme in Reykjavik). The Geothermal Diploma Course in Auckland was for the first years supported by the UNDP and the New Zealand government, but later UNDP withdrew its support. The UNU Geothermal Training Programme in Iceland was established by the United Nations University and the Government of Iceland, and has received support from both throughout its history.

Due to cuts in government financing, the Pisa school has not held its annual course since 1992. The school has, however, during 1985-2003, organized 19 short courses (1-3 weeks) in Africa, Asia, Latin America, the Middle East, and in Central and Eastern Europe (Dickson, 2004). Five of these (in Central and Eastern Europe) have been held in cooperation with the International Summer School (based in Skopje, Macedonia).

Due to drastic cuts in government financing in Japan and New Zealand respectively, the International Group Training Course at Kyushu University was closed in late 2001 (Ushijima, 2002), and the Diploma Course at Auckland University in late 2002 (Watson, 2002). Auckland University will, however, continue admitting students to MSc and PhD studies in geothermal as a part of its regular activities. Kyushu University started a new doctoral course (with Japanese government scholarships) entitled "International Special Course of Environmental Systems Engineering" in 2002. Geothermal energy will be among the topics eligible for such scholarships.

The UNU Geothermal Training Programme (UNU-GTP) is thus at present the only international graduate school offering specialized training in all the main fields of geothermal science and engineering. MSc studies are also offered at the Faculty of Science and the Faculty of Engineering of the University of Iceland in cooperation with the UNU-GTP.

In the last three years, the number of fully funded training places available per year at international geothermal schools has thus decreased from about 50 (Iceland 18-20, Japan 10, New Zealand 20-25) to about 20, which is far from being sufficient as more and more countries are starting to use geothermal resources. Some developing countries, for example the Philippines, have already built up a strong core of geothermal experts with the assistance of the international training centres and by suitably qualified staff working side by side with foreign consultants. Most of the developing countries, however, have a long way to go towards becoming self sufficient in the expertise needed to harness the geothermal energy resources that may reside unused in the countries.

Geothermal training available to Central and Eastern Europe

Despite their long tradition in the direct application of geothermal water in health spas and horticulture, the countries of Central and Eastern Europe (CEE) have in many aspects been isolated and lagging behind in geothermal technology. The opportunities for geothermal training were until the 1990's much more restricted for professionals in these countries than in the developing countries. The short courses organized almost annually by the International Summer School in Skopje (Macedonia) have, however, served a valuable purpose and have created good contacts between specialists in individual countries.

Into the 1990's, only a few of the countries of Central and Eastern Europe were eligible for scholarships awarded through the United Nations. Only those countries which had a recipient status within the United Nations Development Programme (UNDP) could receive UN scholarships for geothermal training. This excluded all the republics of the former Soviet Union. The countries with UNDP recipient status included Albania, Bulgaria, Poland, Romania, Turkey, and the republics of former Yugoslavia, but excluded countries with relatively high per capita income, such as Czechoslovakia and Hungary. The categories of recipient countries were changed within the UN system in the mid 1990´s, with all of the republics of the former Soviet Union and most of the CEE countries becoming eligible for UN fellowships. The only countries within the region with a national income per capita too high to receive UN fellowships were the Czech Republic, Greece (which is also an EU member), Hungary, and Slovenia.

With the entrance of some of the CEE countries into the European Union (EU) in 2004, the situation has changed again. The new member countries of EU previously eligible for UN Fellowships (Estonia, Latvia, Lithuania, Poland, and Slovakia) are not eligible for UN Fellowships any more.

According to available statistics from the four main international geothermal schools in Iceland (Fridleifsson, 2003), Italy (Dickson, 2004), Japan (Ushijima, 2002), and New Zealand (Browne, 2004) the number of participants from the countries of Central and Eastern Europe attending three months or longer training has been as follows: Iceland 52, Italy 35, Japan 35, New Zealand 26, or a total of 148. The 52 people trained in Iceland came from Bulgaria (5), Georgia (1), Greece (3, on special scholarships from Brussels), Latvia (1), Lithuania (2), Macedonia (1), Poland (14), Romania (5), Russia (4), Serbia (3), Slovakia (2), Turkey (9), and Ukraine (2). The 35 people trained in Italy came from Bulgaria (3), Czechoslovakia (1), Greece (10), Hungary (2), Macedonia (1), Poland (2), Romania (3), Turkey (8), and Yugoslavia (5). The 35 people

trained in Japan came from Albania (1) and Turkey (34). The 26 people trained in New Zealand came from Romania (4), Russia (1), Slovakia (1), and Turkey (20).

Excluding participants from Greece and Turkey, the numbers of participants from the CEE countries at the international schools are as follows: Iceland 40, Italy 17, Japan 1, and New Zealand 6, or a total of 64.

As mentioned in the previous chapter, the UNU Geothermal Training Programme (UNU-GTP) is at present the only international graduate school offering specialized training in all the main fields of geothermal science and engineering.

Geothermal training in Iceland

The Government of Iceland and the United Nations University (UNU) decided in 1978 to establish the UNU Geothermal Training Programme (UNU-GTP) in Iceland. Orkustofnun (the National Energy Authority of Iceland) became the host institution of the UNU-GTP. The aim of the UNU-GTP is to assist developing countries and CEE countries with significant geothermal potential to build up groups of specialists that cover most aspects of geothermal exploration and sustainable development. Since 1979, the UNU-GTP has held annual six month courses for professionals from developing countries. Nine specialized lines of training are offered: geological exploration, borehole geology, geophysical exploration, borehole geophysics, reservoir engineering, chemistry of thermal fluids, environmental studies, geothermal utilization, and drilling technology (www.os.is /unugtp/). Each trainee attends only one specialized course. The trademark of the training is to give university graduates engaged in geothermal work intensive on-the-job training in their chosen fields of specialization. The trainees work side by side with geothermal professionals in Iceland. The training is tailor-made for the individual and the needs of his institution/country.

A significant part of the practical training is done in connection with the research projects of the Fellows. In most cases the participants bring with them data from geothermal projects in their home countries, but sometimes the research projects are integrated with geothermal exploration or utilization projects that are in progress in Iceland at the time of training. The project topic is always selected with respect to the conditions of the home country of the participant. All the project reports are published by the UNU-GTP. Since 1994, the reports have been published in the annual book "Geothermal Training in Iceland", which has an international publishing code (ISBN 9979). Copies can be obtained upon request. The reports are mailed regularly to former UNU Fellows and many of the leading geothermal institutions in the developing countries. The titles of the reports from 1979-2003 and the abstracts from 1988-2003 can be found on the home page of the UNU-GTP (www.os.is/unugtp/). From 2002 the complete reports in a pdf version can be accessed from the home page.

Participants are selected by private interviews during site visits to the countries where UNU-GTP representatives make assessments of geothermal fields, research institutions and energy utilities. Participants are selected for training in specializations considered most relevant to promote geothermal development in the respective country. Candidates must have a university degree in science or engineering, a minimum of one year practical experience in geothermal work, speak English fluently, have a permanent position at a public energy company/utility, research institution, or university, and be under 40 years in age.

Participants from developing and most transitional countries have received Fellowships financed by the Government of Iceland and the UNU that cover international travel, tuition fees, and per diem in Iceland. The UNDP and the International Atomic Energy Agency (IAEA) have also financed fellowships for several trainees through the years. Qualified participants from industrialized countries (including EU countries) can also be accepted on condition that they obtain similar scholarships from their own institutions/countries. The total cost per participant is about EUR 30.000.

Since the foundation of the UNU-GTP in 1979, 300 scientists and engineers from 39 countries have completed the annual six month specialized courses offered. Of these, 43% have come from countries in Asia, 25% from Africa, 15% from Latin America, and 17% from CEE. The largest groups have come from China (54), Kenya (33), Philippines (29), El Salvador (20), Ethiopia (20), Poland (14), Indonesia (12), Costa Rica (11), and Iran (10). In many countries, UNU-GTP graduates are among the leading specialists in geothermal research and development. They have also been very active internationally, as exemplified at the World Geothermal Congress in Japan in 2000, where 61 UNU Fellows from 24 countries attended and presented papers. Among these were 14 women.

Institutional environment of geothermal training in Iceland

The UNU-GTP is operated at Orkustofnun, the National Energy Authority of Iceland. Orkustofnun is a government agency under the Ministry of Industry and Commerce. Its main responsibilities have been to advise the Government of Iceland on energy issues and related topics, and to carry out energy research and provide consulting services relating to energy development and utilization. In 2002, 80 research reports were published and 100 scientific papers and abstracts by staff members ap-

peared in refereed journals and conference proceedings.

Orkustofnun has been divided into four independent units: the Energy Management Division, the UNU Geothermal Training Programme (UNU-GTP), the Geoscience Division, and the Hydrological Service Division. The total staff has been about 110, thereof 77% university graduates. Most of the teaching and research supervision of the UNU-GTP has been conducted by geothermal specialists of the Geoscience Division.

In 2003, as a result of changes in the energy legislation in Iceland, the Geoscience Division was separated from Orkustofnun and a new governmentally owned company established with the name Islenskar Orkurannsoknir (ISOR). The English name is ISOR - Iceland GeoSurvey. The principal tasks of ISOR are to conduct research under contract on potential energy resources, their nature and possible utilization; to invent, develop, and adapt methods and equipment to study the country's energy resources; to teach and supervise research students attending the UNU-GTP; and to market its expertise internationally (www.isor.is). The new company continues to work on the same premises and with the same staff as the former Geoscience Division of Orkustofnun. ISOR has a chemical laboratory, geophysical laboratory, petrological laboratory, and three logging trucks for geothermal wells. The capacity of ISOR makes it one of the leading geothermal energy research institutions in the world. The UNU-GTP is located on the same floor of the building as ISOR. Hence, the integration of the UNU Fellows with the specialists and the research atmosphere at ISOR is expected to continue as in previous years. In 2003, specialists at ISOR were responsible for 60% of the training at the UNU-GTP.

The UNU-GTP also has a close cooperation with the University of Iceland (UI). Staff members of the Faculty of Science and the Faculty of Engineering have been amongst the key lecturers and supervisors of the UNU Fellows in some subjects throughout the 25 years of operations of the UNU-GTP. The UNU Fellows have full rights and privileges to use the facilities of the UI as registered students. In May 2000, a special cooperation agreement was signed between the UNU-GTP and the UI on MSc studies in geothermal science and engineering. This is designed for UNU Fellows who have already completed the traditional six month courses at the UNU-GTP. The six month training is an integral part of the MSc programme and accounts for 15 points out of the 60 required for the MSc.

The UNU-GTP has three permanent staff members (employed by Orkstofnun). Dr. Ingvar B. Fridleifsson has been the director of the UNU-GTP from the beginning, except for two breaks, Mr. Ludvik S. Georgsson has been the deputy-director since 1990, and Mrs. Gudrun Bjarnadottir has been the administrative assistant since 1996. Lecturers and support staff are hired from ISOR, Orkustofnun, the UI, and other agencies/companies to meet the training requirements of the UNU Fellows in the respective year. Every year, about 50 specialists from these institutions render such services to the UNU-GTP under specific contracts. This gives the necessary flexibility for providing highly specialized training in the nine fields of specialization offered.

The UNU-GTP is academically governed by a Studies Board, which is composed of nine geothermal experts (from ISOR and UI) responsible for each of the specialized courses that are offered. The UNU-GTP director is the chairman of the Studies Board.

UNU Fellows from CEE countries trained in Iceland

From 1985, 52 UNU Fellows from 13 CEE countries have completed the six month training at the UNU-GTP in Iceland. Many of them are now among the leading geothermal experts of their countries. Most of the UNU Fellows from the CEE counties trained in Iceland are still involved with geothermal work in their home countries, at least to some extent. In her presentation at the International Conference IGC2003 held in Reykjavik to celebrate the 25th anniversary of the UNU-GTP, Kepinska (2003) reviewed the activities of the UNU Fellows from the CEE countries. About 40 of the 52 UNU Fellows (77%) are still active in work related with geothermal and energy matters. They play an important role as members of teams working on geothermal research and development, project implementation, and operations. Many are working in universities and research institutions, where they have the opportunity to spread the knowledge they have acquired in Iceland. Many have also been very active in participating in national and international conferences and are thus keen to update their knowledge.

According to Kepinska (2003), the UNU-GTP has provided "significant and exceptional assistance and support for CEE countries in educating teams of professionals capable of conducting versatile activities aimed at geothermal use and development". But there is always room for improvement. Kepinska (2003) mentions that the potential of many former UNU Fellows themselves could be used more effectively, involving them in more initiatives and projects connected with geothermal energy development to be conducted in their home countries. She suggests that here, the UNU and the Government of Iceland might play a more substantial role in activating national and governmental bodies in the respective CEE countries on a high diplomatic level to inform directly about the scope and amounts of permanent aid available for the

education of geothermal professionals, and the strength of their own highly professional human resources for further geothermal development in the countries concerned. This is an important issue which relates to the promotion of geothermal as an energy source. In many countries, geothermal energy is not included in the national energy plans and is to a large extent ignored by the energy utilities and the respective ministries. The officials are in some cases neither aware of the value of their natural energy resources nor their human resources. This may, however, also reflect that the geothermal specialists are conducting their research within the universities and research institutions with only a limited direct contact with the users of the geothermal energy and the regional/national energy authorities. This is most likely to happen when a country is in the initial stages of using its geothermal resources in a commercial way. Once geothermal energy makes a breakthrough as a viable energy source at community level, it is not looked on as a curiosity any more but considered as a real alternative to polluting coal and oil. As an example, the growing number of municipal geothermal district heating systems in Poland is gradually changing the image of geothermal resources in the country.

There is a considerable difference in the background of many of the UNU Fellows from CEE countries and those who have come from Africa, Asia, and Central America. In the latter three continents, most of the UNU Fellows (over 90%, except in China 80%) have come from national energy companies and geological surveys which are already deeply involved in geothermal exploration and development projects, commonly funded through the national budget or by international aid agencies. Over half of the UNU Fellows from CEE countries have on the other hand come from universities and applied science institutions related to the scientific academies of the respective countries. All of them have, however, been involved with geothermal research projects. Many of them have been very active in giving lectures and in some cases organized geothermal workshops and conferences that have served the European geothermal community.

Table 1 lists the countries and the specialized lines of training of the UNU Fellows from the CEE countries. It is noticeable that all except three have been trained in only four study lines (out of nine): Geothermal Utilization/engineering (18), Reservoir Engineering (15), Chemistry of Thermal Fluids (11), and Borehole Geophysics (5). All are fields that rely to a considerable extent on computer modelling and simulations. No participants have been trained in geological exploration and drilling technology, as these subjects are generally very well mastered in the home countries. With regard to environmental studies, this may also apply, but it can probably also be partially explained by the fact that this specialized line of study was not opened until in 1997.

Table 1: Number of UNU Fellows from the CEE countries and their specializations.

Country	Geological Exploration	Borehole Geology	Geophysical Exploration	Borehole Geophysics	Reservoir Engineering	Chemistry of Thermal Fluids	Environmental Studies	Geothermal Utilization	Drilling Technology	Total
Bulgaria				1	2	2				5
Georgia								1		1
Greece			1					2		3
Latvia								1		1
Lithuania					1			1		2
Macedonia						1				1
Poland				2	5	1		6		14
Romania						1		4		5
Russia					2	2				4
Serbia				1	1	1				3
Slovakia				1	1					2
Turkey		1			1	3	1	3		9
Ukraine					2					2
Total CEE	0	1	1	5	15	11	1	18	0	52

Poland has the largest number of UNU-GTP graduates (14). Of these, 6 have studied Geothermal Utilization, and 5 Reservoir Engineering. Seven are based in Krakow and work at the University of Mining and Metallurgy (3), institutions of the Polish Academy of Sciences (3), and the AGH University of Science and Technology (1). They have studied and are teaching/conducting re-

search in Geothermal Utilization (3), Borehole Geophysics (2), Reservoir Engineering (1), and Chemistry of Thermal Fluids (1). Three are research workers at the Faculty of Engineering at the Technical University of Szczecin. Two are teaching/conducting research in reservoir engineering at the Faculty of Earth Sciences of the University of Silesia. One of the first UNU Fellows coming from Krakow (in 1991) later became the founding director of the largest geothermal district heating system in Poland (Zakopane, Podhale region). There is no question that several of these good professionals could form the core of teachers/trainers of an international post-graduate training programme in geothermal energy related to their specialized fields. They might, however, need to secure direct participation in commercial geothermal utilization projects in order to serve as best the training needs of the growing geothermal industry in Poland and neighbouring countries. Figure 1 shows the UNU-GTP Class of 1991, with the first two UNU Fellows from Poland, the first from Slovakia and the third from Serbia.

Figure 1. The UNU-GTP Class of 1991 with four CEE participants.

Turkey has the second largest number of UNU-GTP graduates (9). Of these, 3 have studied Geothermal Utilization and 3 Chemistry of Thermal Fluids. Five of the graduates are university professors or lecturers, but they work at five different universities. They give lectures on geothermal energy at their universities. But it would be difficult for them to organize a post-graduate training programme in geothermal energy due to the fact that they work so far from each other. Two of the graduates are post-graduate research students at universities. Two of the early graduates work with geothermal consulting companies. With the rapid expansion of direct utilization of geothermal energy in Turkey, the need for geothermal training is increasing. Through close cooperation of the geothermal utilities and the research departments of the universities, Turkey may become an ideal training ground in exploration and direct utilization of geothermal energy.

Romania has five UNU-GTP graduates, all teaching/researching at the University of Oradea. Four of them have studied Geothermal Utilization and one Chemistry of Thermal Fluids with special emphasis on corrosion and scaling. The University of Oradea has established an International Geothermal Training Centre, but so far there have not been held any regular courses at the centre. The European Summer School on Direct Applications of Geothermal Energy was, however, held there with great success in 2001. This centre will be in a good position to organize courses on the direct use of geothermal energy in the future.

Next steps in geothermal training in CEE countries

Significant experience is available in a dozen European countries in geothermal exploration and development. Several CEE countries have built up strong groups of geothermal professionals. Many of the key people of these groups have received train-

ing at the international geothermal schools, but most of the training has taken place on the job in the respective countries. But the manpower resources are unevenly distributed. More training is needed for people in several CEE countries, both at professional and technician levels, to speed up the development of the geothermal resources for the benefit of the environment and the well being of the people. This may also save repeating the mistakes that their neighbours have made under similar conditions in the years past. Many CEE countries have completed initial surveys and have in some cases started utilization projects of their geothermal resources and are at a stage of wishing to develop the resources using up-to-date technology. They are, however, in many cases handicapped both by the lack of financing and the needed infrastructure of trained personnel.

As mentioned earlier in the paper, the UNU Geothermal Training Programme (UNU-GTP) is at present the only international graduate school offering specialized training in all the main fields of geothermal science and engineering. The UNU-GTP gives preference to qualified candidates from CEE countries eligible for UNU Fellowships who are directly involved with geothermal projects, as long as the projects are considered to be of national or regional value. The number of UNU Fellowships is, however, limited. Qualified candidates from EU countries can only be accepted for the six month training on the condition that they are supported by grants equal to those of the UNU Fellowships.

In view of the emphasis of the European and the international community on substituting polluting fossil fuels with renewable energy, the time has probably come to consider the establishment of an international geothermal training centre specially focusing on the needs of the CEE countries. The International Geothermal Training Centre at the University of Oradea in Romania, and a similar training centre (e.g. in Poland and/or Turkey) focusing on other specialized subjects, may in the future serve an important role for geothermal training in Central and Eastern Europe.

In the plans of the UNU-GTP for 2005-2007, the core activity will continue to be specialized six month training with about 20 Fellows annually. The present MSc programme with the University of Iceland is expected to expand from 5 to 10 MSc students per year. New activities will involve short courses in Africa (Kenya, Ethiopia, Uganda) under the REEEP initiative (Johannesburg Summit 2002) which are planned to start in Kenya in 2005 in cooperation with KenGen and UNEP/GEF. The Government of Iceland made a further commitment at the International Conference for Renewable Energies (in Bonn, June 2004) to provide the core funding for short specialized courses in geothermal development conducted in selected countries in Africa, Asia, and Central America. The courses will be set up in cooperation with the energy agencies/utilities and earth science institutions responsible for the exploration, development and operation of geothermal energy power stations and utilities in the respective countries. The teaching will be in the hands of UNU-GTP graduates in the respective countries/regions and the regular teachers of the UNU-GTP. The time plans for the first courses in Asia and Central America have tentatively been set for 2006-2008. Longer term goals of the United Nations University and the UNU-GTP are to assist in the establishment of formal training centres with former UNU Fellows as main teachers in e.g. China, El Salvador, Kenya, and Philippines.

The UNU-GTP would be prepared to assist in the establishment of an international geothermal training centre(s) focusing on the needs of the CEE countries. The core funding for such a centre would most logically come from the EU. The teaching material prepared for the regular operations of the UNU-GTP together with the material prepared for the short courses in Africa, Asia, and Central America, could be adapted and shared with such international geothermal training centres in the CEE countries under a cooperation agreement.

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