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UNU-GTP CAPACITY BUILDING AND CENTRAL AMERICA

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ABSTRACT

The main goal of the UNU-GTP is capacity building in the sustainable use of geothermal energy resources. Nine specialized lines of training are offered www.os.is/unugtp/). The aim is to assist developing and transitional countries with significant geothermal potential to build up groups of specialists that cover most aspects of geothermal exploration and development. Since the foundation of UNU-GTP in 1979, 359 scientists and engineers from 40 countries have completed the annual six month courses. Of these, 44% have come from countries in Asia, 26% from Africa, 16% from Central and Eastern Europe, and 14% from Latin America. All participants are selected by private interviews during site visits to the countries concerned. They are trained in the specialized fields that are 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.

The Government of Iceland has secured core funding for the UNU-GTP to expand its capacity building activities by annual workshops/short courses in geothermal development in selected countries in Africa (started in 2005), Central America (starting in 2006), and in Asia (probably starting in 2007). This is a contribution of the Government of Iceland towards the Millennium Development Goals of the United Nations. A part of the objective is to increase the cooperation between specialists in the respective countries/regions. The courses may in the future develop into sustainable regional geothermal training centres. The first workshop in Central America is co-hosted by LaGeo S.A de C.V. in El Salvador. Participants are mainly from the four countries of Central America active in geothermal development. The aim of the workshop is to give high level decision makers from the respective energy and environmental ministries, leading geothermal agencies, and electric utilities in the region an overview of some of the key issues of geothermal development, with a special focus on environmental issues.

Central America is one of the world's richest regions in geothermal resources. Geothermal power stations provide about 12% of the total electricity generation of the four countries Costa Rica, El Salvador, Guatemala and Nicaragua. Only a small portion of the geothermal resources in the region has been harnessed so far. With the large untapped geothermal resources and the significant expertise and experience in geothermal development in the region, Central America may become an international example of how to reduce the overall emission of greenhouse gases in a large region.

1. INTRODUCTION

The Government of Iceland and the United Nations University (UNU) decided in 1978 to establish the UNU Geothermal Training Programme (UNU-GTP). Orkustofnun (the National Energy Authority of Iceland, NEA) became the host institution of the UNU-GTP. Specialized training is offered in 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/). The aim is to assist developing countries and Central and Eastern European countries with significant geothermal potential to build up groups of specialists that cover most aspects of geothermal exploration and sustainable development

The trademark of the UNU-GTP 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/her institution/country. All participants are selected by private interviews during site visits to the countries concerned where UNU-GTP representatives visit geothermal fields, research institutions and energy utilities. Participants are selected for training in the specialized fields that are considered most relevant to promote geothermal development in the respective country. The 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 agency/utility, research institution, or university, and be under 40 years.

During 1979-2006, 359 scientists and engineers from 40 countries have completed the annual six month courses. Of these, 44% have come from countries in Asia, 26% from Africa, 16% from Central and Eastern Europe, and 14% from Latin America. There have been 57 women (16%). Over 80 professionals have received shorter training (2 weeks to 4 months). In 2000, a MSc programme in geothermal science and engineering was started in cooperation with the University of Iceland. Nine have graduated from the MSc programme and eight are presently pursuing their MSc studies. In many countries in Africa, Asia, Central America and Central and Eastern Europe, UNU-GTP graduates are among the leading specialists in geothermal research and development. They have been very successful, and have contributed significantly to energy development in their parts of the world. The UNU-GTP is (since 2003) the only international graduate school offering specialized training in all the main fields of geothermal science and engineering.

The UNU-GTP has three permanent staff members (employed by NEA), but lecturers and supervisors are hired from Iceland GeoSurvey (ISOR), the University of Iceland, and other agencies/companies. Every year, about 50 staff members of these institutions render services to the UNU-GTP under contracts. This allows the flexibility required to provide highly specialized training in the nine fields of specialization offered. Teaching and research supervision at the UNU-GTP has in the last few years been carried out by geothermal specialists of ISOR 60%, the University of Iceland 20%, and specialists at other institutions, energy utilities and consulting engineering offices 20%. The availability of top grade supervisors for the various specialized lines of studies offered is of vital importance to the UNU-GTP operations.

2. SPECIALIZED TRAINING

The approximate time schedule of the six month specialized courses is shown in Table 1. All participants attend an introductory lecture course (5 weeks, three lectures per day) which aims to provide background knowledge on most aspects of geothermal energy resources and technology, and to generate an appreciation for the interrelationship between the various disciplines necessary in geothermal projects from the initial exploration to the stages of implementation and utilization. Participants have to take two written tests during the introductory lecture course. The introductory course is followed by lectures and practical training in the respective specialized fields (7 weeks), and

the execution of a research project (12 weeks) which is concluded with an extensive research project report. Excursions are also arranged to the main geothermal fields under exploration and utilization in Iceland. Seminars are held and case histories studied on each of the fields.

The main emphasis of the training is to provide the participants with sufficient understanding and practical experience to permit the independent execution of projects within a selected discipline in their home countries. Nine specialized lines of training are offered (Table 1). Each participant is meant to follow only one line of training, but within each line there is considerable flexibility. A detailed description can be found on the home page of the UNU-GTP (www.os.is/unugtp/).

TABLE 1: Approximate time schedule for the six month specialized courses at UNU-GTP

UNU GEOTHERMAL TRAINING PROGRAMME IN ICELAND

Week	Geological Exploration	Borehole Geology	Geophysical Exploration	Borehole Geophysics	Reservoir Engineering	Environmental Studies	Chemistry of Thermal Fluids	Geothermal Utilization	Drilling Technology
1 2 3 4 5	Lecture course on all main aspects of geothermal energy exploration and utilization, practicals and short field excursions								
6 7 8 9 10	Field geology Maps and photos Structure analysis Hydrogeology	Drilling Petrological logging Alteration Mineralogy	Resistivity methods Thermal methods Magnetics Gravity	Course on well logging and reservoir engineering including: Logging and well testing practises Reservoir physics Reservoir simulation Tracer tests Computer programs		EIA Project planning Chemistry Physics Biology Monitoring Revegetation Health and safety	Sampling of fluids and gas Scaling and corrosion Analytical methods Thermodynamics Geothermometers	Heat transfer and fluid flow Control systems	Drilling equipment Drilling procedures Well design Safety Management Rig operations
11 12			Excursion to the main geothermal fields of Iceland						
13 14	Field work in deeply eroded strata	Aquifers Modelling	Data processing techniques	Logging methods Data evaluation	Responses to exploitation	Gas dispersion and abatement	Water rock interaction	Design of plants and systems	Cementing Completion
15 16 17 18 19 20 21 22 23 24 25 26	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report

Most of the teaching is done by tutorials and practical work where the teacher works with two or three trainees and use is made of available textbooks and articles in journals as appropriate. In some instances, however, text material and manuals have been made for the training. Some of the teaching material has been published in reports, and is available from the UNU-GTP. UNU Fellows have in many cases used teaching material from the UNU-GTP to train colleagues in their own institutions.

A significant part of the practical training is done in connection with the research projects of the Fellows. In many cases, the participants bring with them data from geothermal projects in their home countries. The project topic is always selected with respect to the conditions of the home country of the participant. All project reports are published by the UNU-GTP. Since 1994, the reports have been published in the annual book “Geothermal Training in Iceland” (edited by Ludvik S. Georgsson, international publishing code (ISBN 9979-68). Copies can be obtained upon request. The books are mailed regularly to former UNU Fellows, universities and leading geothermal research institutions in over 50 countries. The titles of the research reports from 1979-2006 are listed in the home page of the UNU-GTP (www.os.is/unugtp/). Abstracts of reports since 1988 and the complete reports since 1999 are also available on the home page.

On many occasions, UNU Fellows from a given country (e.g. Costa Rica, El Salvador, Kenya, Philippines) conduct over several years multidisciplinary research (geology, geophysics, chemistry, reservoir engineering, environmental impact studies) on data from the same area in their home countries under supervision of Icelandic specialists. All of the countries mentioned above obtain 15-22% of their electricity from geothermal steam.

Table 2 lists the countries of origin of the participants who have completed the six month training during 1979-2006, and their specialized courses. Figure 1 shows the same on a world map. The largest groups have come from China (64), Kenya (39), Philippines (31), Ethiopia (23), El Salvador (22), and Indonesia (20). Thirteen other countries have sent 5-17 participants.

TABLE 2: Fellows of the UNU Geothermal Training Programme in Iceland 1979-2006

Country	Geological exploratio	Borehole geology	Geophysical	Borehole geophysics	Reservoir engineerin	Chemistry of therm.	Environmen. studies	Geothermal utilization	Drilling technology	Total
Algeria	1					1		1		3
Azerbaijan							1			1
Bulgaria				1	2	2				5
Burundi	1									1
China		3	1	2	22	13	8	13	2	64
Costa Rica	2	2	2		2	2	2	1		13
Djibouti		1			1					2
Egypt		1		1	1	1				4
El Salvador	1	1	2	2	5	4	2	2	3	22
Eritrea	2		1			1				4
Ethiopia		3	3	1	5	3	1	5	2	23
Georgia								1		1
Greece			1					2		3
Guatemala		1			1	1				3
Honduras		1	1							2
Indonesia		4	3	2	5	1	1	4		20
Iran	1	3	1	1	1		2	6	1	16
Jordan				1	1	1		1		4
Kenya	1	4	8		6	6	7	3	4	39
Latvia								1		1
Lithuania					1			1		2
Macedonia						1				1
Mexico	1		1		2					4
Mongolia	1		1		1	1		4		8
Nepal						1		1		2
Nicaragua					3	2				5
Pakistan	1	1			1	1				4
Philippines		4	5	4	9	6		3		31
Poland				2	5	1		6		14
Romania						1		4		5
Russia					2	5	1			8
Serbia				1	1	1				3
Slovakia				1	1					2
Tanzania	2									2
Thailand		1		2		1		1		5
Tunisia					1			5		6
Turkey		1			1	4	1	3		10
Uganda	3	1	1		1	3				9
Ukraine					2					2
Vietnam	1		1		1	1			1	5
Total	18	32	32	21	84	65	26	68	13	359

Regular contact is held with former UNU Fellows by sending them the UNU-GTP yearbook and an annual newsletter. The majority of the Fellows keep in contact with the UNU-GTP and each other through correspondence. This has become much easier lately as some 270 former UNU Fellows (out of 359 graduates) are listed in the e-mail directory of the UNU-GTP. An updated directory is sent out twice per year to all alumni of the Programme.

3. SELECTION OF PARTICIPANTS AND SITE VISITS

Candidates for participation in the specialized training must have a university degree in science or engineering, a minimum of one year practical experience in geothermal work, speak English fluently, be under 40 years in age, and have a permanent position dealing with geothermal energy at an energy company/utility, research institution, or university in their home country.

Much care is taken in selecting the participants. Site visits are conducted by representatives of the UNU-GTP to the countries requesting training. The potential role of geothermal energy within the energy plans of the respective country is assessed, and an evaluation made of the institutional capacities in the field of geothermal research and utilization. Based on this, the training needs of the country are assessed and recipient institutions selected. The directors of the selected institutions are

invited to nominate candidates for training in the specialized fields that are considered most relevant to promote geothermal development in the respective country. All qualified candidates are interviewed personally. Training starts in late April and ends in late October each year. Nominations (including the curriculum vitae of the candidates) must be received in Reykjavik before 1st September each year for participation in training starting the following year.

Participants from developing countries and most CEE countries (not EU members) normally receive scholarships 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. With the entrance of some of the CEE countries into the European Union (EU) in 2004, countries previously eligible for UNU Fellowships (Estonia, Latvia, Lithuania, Poland, and Slovakia) are not eligible any more. Qualified participants from industrialized countries (including EU) can be accepted for UNU-GTP training if they have similar scholarships from their own countries.

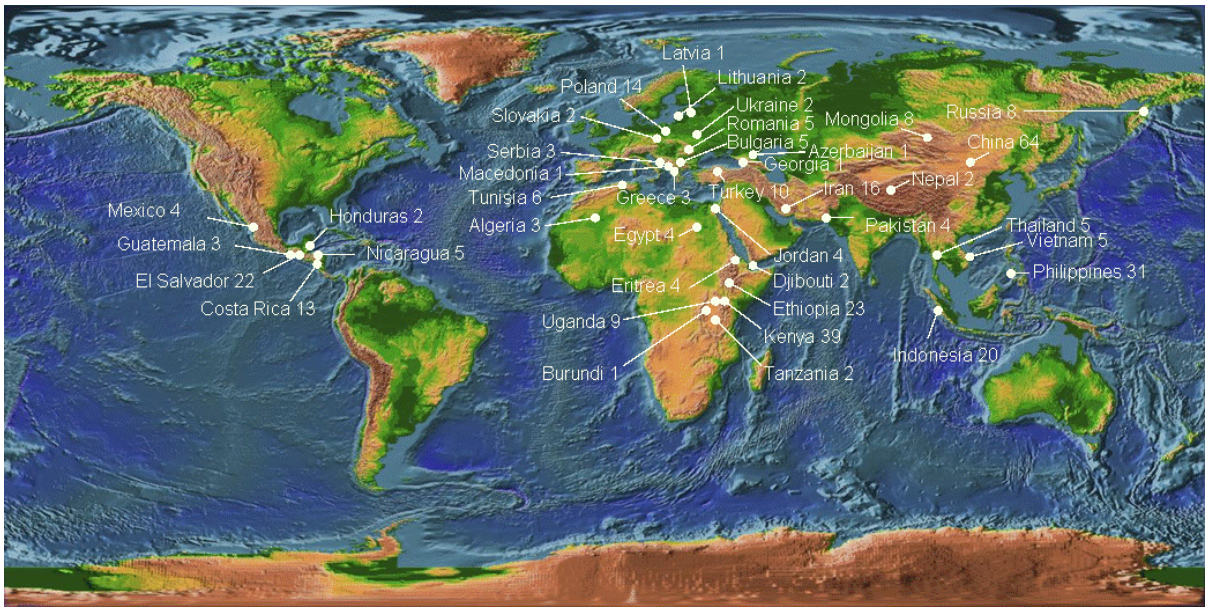

FIGURE 1: Countries and numbers of graduates completing six month courses 1979-2006

The site visits have played a very significant part in the work and in the success of the UNU-GTP. Since 1979, a total of 161 site visits have been conducted to countries requesting training, an average of 6 site visits per year. The visits have been made by the permanent staff of the UNU-GTP (70%), and members of the Studies Board and other geothermal specialists (mostly from ISOR). In addition to visiting geothermal fields, research institutions, and interviewing candidates, the UNU-GTP representatives commonly give lectures. Many site visits are planned to coincide with regional conferences and seminars. In connection with the site visits, meetings are held with the UNU-GTP alumni in each country/region as practicable.

The site visits are very valuable for the quality of the training. The private interviews with candidates are aimed to secure the quality of the selected Fellows. During the 28 years of the UNU-GTP, only seven UNU Fellows (out of 366) have been unable to complete the six months of training, mostly for medical reasons. The visits to institutions and geothermal fields aim to tailor the training to the needs of the country and the institutions from which the candidates come. The site visits have, without doubt, contributed very significantly to the successful transfer of technology from Iceland to the recipient countries. A wealth of information and practical experience has been gathered and shared between the various countries participating in the UNU-GTP activities. The site visits have contributed significantly to make the UNU-GTP an international centre of learning.

4. MASTER OF SCIENCE PROGRAMME

Since 2000, seventeen former UNU Fellows have been admitted to a MSc programme in geothermal science and engineering in cooperation with the University of Iceland (UI). Many of our trainees have already completed their MSc or PhD degrees when they come to Iceland, but several excellent students who have only BSc degrees have made requests to come again to Iceland for a higher academic degree. Their six months in the UNU-GTP fulfil 25% of their MSc programme credit requirements. The aim of establishing the MSc programme in cooperation with the UI is to go a step further in assisting selected countries in building up their specialist groups.

A total of nine scientists and engineers have graduated with MSc during 2001-2006. Five have come from Kenya (graduated in 2002, 2004, 2006), and one from each of Iran (2005), Jordan (2001), Mongolia (2005), and Uganda (2005). The MSc theses have been published in the UNU-GTP publication series, and can be obtained from the UNU-GTP home page (www.os.is/unugtp/).

There are eight UNU Fellows in the MSc programme in the autumn term of 2006. They come from China (1), Djibouti (1), Iran (2), Kenya (2), Mongolia (1), and the Philippines (1).

5. BUILDING OF SPECIALIST GROUPS

The aim of the UNU-GTP is to concentrate its training efforts to assist in building up groups of specialists in the geothermal departments of selected countries with significant geothermal potential. Priority for training is given to candidates from carefully selected institutions from developing countries and Central and Eastern European countries where geothermal exploration and development is already under way. The limiting factor is, in some cases, the availability of sufficiently qualified staff in the recipient institutions. The fact that participants must speak English fluently has, for example, hampered participation from certain parts of the world such as Latin America.

Figure 2 shows the number of Fellows completing the six month specialized training per year during 1979-2006 and the MSc students. The number of Fellows has gradually increased, mostly controlled by available financing. There have always been waiting lists of qualified candidates. In the last few years, there have been 18-21 Fellows graduating after six month courses and 4-9 MSc Fellows.

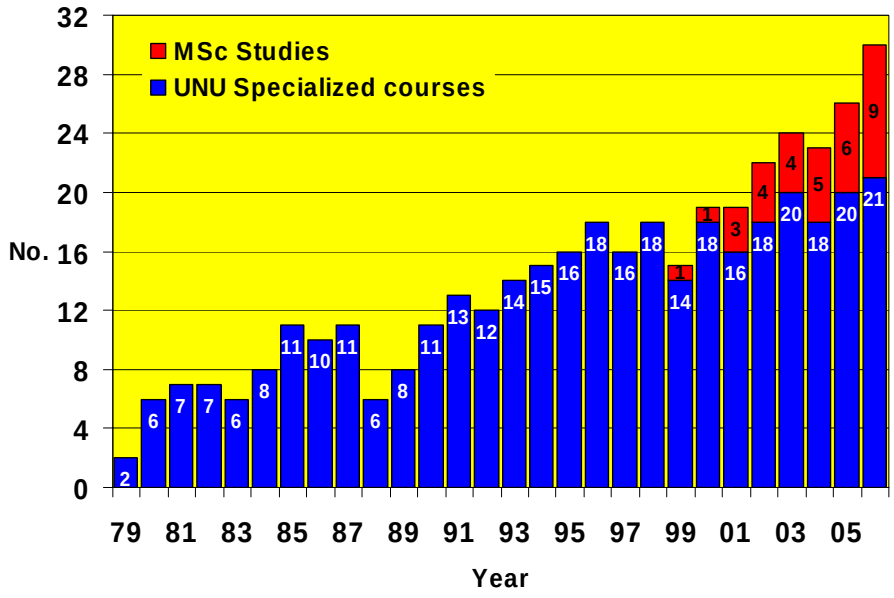

Figure 2: Number of Fellows completing six month courses and studying for MSc 1979-2006

The first participants in the UNU-GTP from Central America were J. Luis Zuniga from El Salvador and Jorge Flores from Honduras in 1980. Barrios (2006) has written an excellent paper on the contribution of the UNU-GTP Fellows from Central America and Mexico to the geothermal development in their respective countries. Table 3 shows the number of Fellows from Central America and their specializations. Professionals from El Salvador have participated in all nine specialized courses and Costa Rican professionals in seven of the courses. In the class of 2006, there were two scientists from the Instituto Costarricense de Electricidad (ICE) in Costa Rica and one from the National Autonomous University of Nicaragua (UNAN-LEON). The UNU-GTP is very proud of the achievements of its graduates in Central America and looks forward to having many geothermal professionals from the region in the coming years.

TABLE 3: Number of UNU Fellows from Central America and their specializations 1980-2006

	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua
Geological Exploration	2	1			
Borehole Geology	2	1	1	1	
Geophysical Exploration	2	2		1	
Borehole Geophysics		2			
Reservoir Engineering	2	5	1		3
Chemistry of Fluids	2	4	1		2
Environmental Studies	2	2			
Geothermal Utilization		2			
Drilling Technology	1	3			
Total	13	22	3	2	5

At the International Geothermal Conference held to celebrate the 25th anniversary of the UNU-GTP, former UNU Fellows presented papers on the contribution of UNU-GTP training to geothermal development in Africa, Asia, Central America, Central and Eastern Europe, and China (Mwangi, 2003; Benito and Reyes, 2003; Barrios, 2003; Kepinska, 2003; Zhao et al., 2003, respectively – the papers can be obtained at www.os.is/unugtp/ under Special Events – 25th Anniversary). These papers give valuable assessments on the UNU-GTP from the point of view of the respective regions.

Generally speaking, the effort to have the training tailor-made to the abilities of the individual and the needs of the recipient country/institution, seems to have been very successful. The number of fully qualified applicants each year is normally much greater than the number of scholarships available. As mentioned before, all the participants are selected after private interviews by UNU-GTP staff, and on the recommendation of the recipient institutions. It is, therefore, not surprising that many of the former trainees have become the leading specialists in their countries in their given fields. Our records indicate that about 80% of all our trainees have continued working in the geothermal sector for five years or more after their training in Iceland.

6. PARTICIPATION IN WORLD GEOTHERMAL CONGRESS

The International Geothermal Association organizes the World Geothermal Congress every five years. The third such congress was held in Turkey in April 2005 (WGC 2005) with over 1300 participants from 80 countries. The UNU-GTP in Iceland was very well represented at the WGC 2005. Among the 705 refereed papers accepted by the Technical Committee for presentation (oral and poster), 141 papers (20%) were authored or co-authored by 104 former UNU Fellows from 26 developing and transitional countries. The papers were divided between 23 of the 24 technical sessions of the

conference. The level of activity of the UNU Fellows in the international geothermal community is well reflected in the fact that a third of the 318 graduates of the UNU-GTP from 1979-2004 were authors of refereed papers at the congress. The papers are accessible on the home page (www.os.is/unugtp/).

FIGURE 3: UNU Fellows with UNU-GTP staff and Studies Board at the WGC 2005 in Turkey. A third of the 318 UNU Fellows graduating 1979-2004 were authors of papers at the congress.

Seventy seven former UNU Fellows from 25 countries attended the congress in Turkey. Most of them received travel fellowships funded by the UNU-GTP in Iceland and the UNU Centre in Japan. Sixty one attended the WGC 2000 in Japan (out of 227 graduates at that time) and 35 the WGC 1995 in Italy (out of 161 graduates). The UNU-GTP policy to support the participation of former UNU Fellows in the WGC every five years has made it possible for a large number of professionals from all continents to share their research results and experience with the international geothermal community. Their enthusiasm and hard work gives them the opportunity to keep up with new technical developments as well as the pleasure of meeting friends and colleagues from various parts of the world, reminisce about the past, and plan for the future. These are the pillars of the network of UNU-GTP Fellows worldwide.

7. GEOTHERMAL WORKSHOPS AS CONTRIBUTION TO UN MILLENNIUM GOALS

The Government of Iceland has secured core funding for the UNU-GTP to expand its capacity building activities by annual workshops/short courses in geothermal development in selected countries in Africa (started in 2005), Central America (starts in 2006), and later in Asia (probably starting in 2007). The announcement on this was made at the International Conference for Renewable Energies held in Bonn (Germany) in June 2004. This is a contribution of the Government of Iceland towards the Millennium Development Goals of the United Nations.

The courses/workshops are 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/regions. A part of the objective of the workshops/short courses is to increase the cooperation between specialists in the respective countries in the field of sustainable use of geothermal resources. The courses may in the future develop into sustainable regional geothermal training centres.

FIGURE 3: Participants in the first UNU-GTP Workshop in E-Africa were high-level decision makers from five countries in E-Africa (Eritrea, Ethiopia, Kenya, Tanzania, and Uganda).

The first workshop in Africa (entitled "Workshop for Decision Makers on Geothermal Projects and their Management") was held in Kenya in November 2005 with participants from Eritrea, Ethiopia, Kenya, Tanzania and Uganda. It was co-hosted by the UNU-GTP and the Kenyan Elelctricity Generating Authority (KenGen), and organized in cooperation with UNEP (United Nations Environment Programme) and ICEIDA (Icelandic International Development Agency). The proceedings were published on a CD (Fridleifsson and Simiyu, 2005). The second was a short course held in Kenya 12-22 November 2006. It was entitled "Surface exploration for geothermal resources". The course dealt with geological, geophysical, and geochemical exploration methods. Partcipants came from seven E-African countries. The lecturers were (as in 2005) mainly former UNU Fellows from Kenya and one from Ethiopia, plus four lecturers from Iceland. The UNU-GTP has 93 graduates in 10 African countries.

8. WORKSHOPS AND COURSES IN CENTRAL AMERICA

The first workshop in Central America will be held in El Salvador 26 November – 2 December 2006. It is entitled "Workshop for Decision Makers on Geothermal Projects in Central America", and will be co-hosted by the UNU-GTP and LaGeo S.A de C.V. in El Salvador. The participants will be decision makers and prime movers/specialists of geothermal project activities in Central America. The aim of the workshop is to give high level decision makers from the respective energy and environmental ministries, leading geothermal agencies, and electric utilities in the region an overview of some of the key issues of geothermal development, with a special focus on environmental issues. Lecturers will include former UNU Fellows and other geothermal specialists from Costa Rica, El Salvador, Guatemala and Nicaragua plus three regular lecturers of the UNU-GTP. Lecturers will also be invited from Kenya, Philippines, USA, and Mexico. The UNU-GTP has 49 graduates in six Latin American countries.

The Workshop will be opened by Her Excellency the Minister of Economy of El Salvador. The Workshop will consist of eight technical sessions with the following titles: Geothermal resources worldwide and in Central America; Environmental and social issues in geothermal development; Geothermal development in the vicinity of national parks and protected areas; Geothermal projects:

Financing, ownership, licensing and concessions; Geothermal utilization and field management; Geothermal field development; Lessons learned from geothermal development; and Human resources development. In addition to an opening session and a session on Conclusions and Recommendations, there will also be a Panel session on the Future of geothermal development in Central America. A whole day excursion will be made to the Berlin geothermal field.

As mentioned previously (Chapter 7), the Workshop is the first of annual workshops/short courses to be held in Central America by the UNU-GTP and host institution(s). Among the topics discussed on the final day of the Workshop will be the selection of topics for specialized short courses to be held in the next two or three years.

Central America is one of the world's richest regions in geothermal resources. Geothermal power stations provide about 12% of the total electricity generation of the four countries Costa Rica, El Salvador, Guatemala and Nicaragua, according to data provided from the countries at the World Geothermal Congress in 2005. Only a small portion of the geothermal resources in the region has been harnessed so far. With the large untapped geothermal resources and the significant expertice and experience in geothermal development in the region, Central America may become an international example of how to reduce the overall emission of greenhouse gases in a large region.

This will require considerable human capacity building in geothermal research and development in the region. Table 5 (from Fridleifsson, 2006) shows the top fifteen countries in the world with the highest % share of geothermal in their national electricity production and the number of UNU Fellows trained in Iceland. Many of the leading geothermal experts in the top countries are graduates of the UNU-GTP. Special attention is drawn to that El Salvador, Costa Rica and Nicaragua are among the six top countries in Table 5, and Guatemala is in eleventh place.

TABLE 4: Top fifteen countries with highest % share of geothermal in their national electricity production and number of UNU Fellows trained in Iceland

Geothermal electricity production			
Country	**GWh/a**	**% national electricity**	**Number of UNU-GTP Fellows**
El Salvador	967	22.0	22
Kenya	1,088	19.2	39
Philippines	9,253	19.1	31
Iceland	1,483	17.2	
Costa Rica	1,145	15.0	13
Nicaragua	271	9.8	5
Guadeloupe (France)	102	9.0	
New Zealand	2,774	7.1	
Indonesia	6,085	6.7	20
Mexico	6,282	3.1	4
Guatemala	212	3.0	3
Italy	5,340	1.9	
USA	17,917	0.5	
Japan	3,467	0.3	
China	96	30% of Tibet	64

The UNU-GTP would like to support the countries of Central America in expanding the sustainable use of their geothermal resources. The UNU-GTP welcomes applications from qualified candidates (see Chapter 3) from geothermal research institutions, energy companies and utilities as well as universities in Central America for the six month courses and the MSc programme. It would be a big step forward if one or more universities in the region would include geothermal energy research and

development in the syllabus of their faculties of science and engineering, especially if this would be done in cooperation with geothermal energy institutions/utilities in the region. This could start as optional courses in advanced undergraduate or post-graduate studies in science or engineering.

9. FUTURE PLANS OF THE UNU-GTP

In the coming five years, the core activity of the UNU-GTP will continue to be specialized training in Iceland. About 20 UNU Fellows will be accepted per year for the six month courses, and the MSc programme will be expanded to admitting up to six former UNU Fellows annually for MSc studies (18-24 months). PhD studies are under consideration with one or two fellowships per year. The series of annual workshops/courses in Africa, Asia, and Central America will involve a considerable expansion in the activities of the UNU-GTP.

The Government of Iceland contributes a higher amount annually to the UNU than any other institution within the UN system. It is no coincidence that the two UNU programmes, UNU-GTP and the UNU-Fisheries Training Programme (UNU-FTP), are hosted in Iceland. Both of these specialities are of national importance. The technically highly developed and sustainable use of the fisheries resources, and the renewable energy resources (geothermal and hydropower) have been instrumental in bringing Iceland from the category of developing countries in the early 1960s, to the ranks of the ten countries with the highest BNP/capita since the 1980s. Iceland is willing to share its experience with the developing and transitional countries.

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