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25th Anniversary of UNU/GTP Programme

Setting the course: the UNU Geothermal Training Programme

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This year, the United Nations University Geothermal Training Programme (UNU/GTP) celebrates its 25th anniversary. An excellent occasion to congratulate all who have been involved in this successful programme; some of them from the beginning.

In 2000, I myself attended part of the World Geothermal Congress, in Morioka, Japan, and was happy to see that the UNU/GTP is not only just a programme with a long history. Indeed, it has turned out a large number of experts who now, each of them, are serving their country in the crucial energy sector. In trying to contribute to "*a better life, and a safer world for all people, including future generations*", people around the world have to share their knowledge about the optimal use of available natural resources. Iceland, and the Geothermal and Fisheries Training Programmes (UNU/GTP and UNU/FTP, respectively), have taken the lead in the world in such knowledge sharing which aims to benefit large parts of the developing world and countries in transition. UNU is proud of both these programmes, and is looking for other important natural resources to start new activities that can help improve the living conditions in large parts of our shrinking world.

The United Nations has the responsibility to preserve international peace and promote human development. The UN Charter codifies best-practice state behaviour. The United Nations University has the mandate to link the normally isolated worlds of scholarship, policy-making and practical implementation. It is the embodiment of the UN ideal with regard to the international community of scholars. Lying at the interface of ideas, international organizations, international public policy, and implementation, it seeks to harness knowledge for the promotion of human security and human development, and put tomorrow's issues on today's agenda; theory into practice. It also tries to strengthen the capabilities of people to improve their living conditions in innovative and practical ways, in crucial areas such as water, energy, food security, environmental degradation and biodiversity. The method of the UNU – policy-oriented research, reflection and capacity-building, especially in developing countries, through a global network of high-level practitioners, scholars, academic institutions and think tanks – distinguishes us from the other UN organizations as well as from other universities.

In his report "*Strengthening the United Nations: An Agenda for Further Change*" (UN September 2002, Document A/57/387, p. 6, para. 2), Secretary-General Annan stressed, among other points, that:

> … *"This new age of interdependence and integration offers many opportunities to all the peoples of the world, but it also poses many dangers. The challenge ahead is to strengthen our capability for collective action and thus forge a common destiny in a time of accelerating global change."* …

Much scientific knowledge that already exists in pockets of advanced societies is yet to be diffused to the rest of the world. In other respects, the existing knowledge base is inadequate to the magnitude of the tasks confronting us. Rapid development and diffusion of science and technology are the driving forces of modern development and global economic integration. But the harnessing of scientific knowledge and technological enterprise for the betterment of society has been extremely uneven across the world. Those of us who take their desktop, portable, palm/handheld, and mobile for granted, tend to forget that most people in the world have not even used a telephone once in their lives.

Science and technology can be used to increase the volume or the nutritional value of food, as UNU aims to do through its Institute for Natural Resources in Africa (UNU/INRA in Accra, Ghana); its Food and Nutrition Network coordinated from Cornell University; and its Fisheries Training Programme in Iceland (UNU/FTP). Science and technology can also help to manage available freshwater resources better – to monitor pollution, and to treat water to make it safe for drinking – on which the activities of UNU's Network on Water, Environment and Health (UNU/INWEH in Hamilton, Canada), as well as some of the projects of the Environment and Sustainable Development Programme in Tokyo (UNU/ESD) are focusing. Science and technology can also contribute applications in industrial engineering, and to abatement of polluting after effects as is being done in the framework of UNU's Zero Emissions Forum (UNU/ZEF), its Eco-Restructuring Project, and its Coastal Hydrosphere Project supported by Shimadzu Corporation. This last project is particularly interesting as it helps ten countries in Asia and the Pacific to address pollution problems in their coastal waters which are caused by agriculture, as fertilizers and insecticides are transported by ground and surface water to the sea. Science and technology also plays an important role in UNU's activities with regard to biodiversity and the Millennium Ecosystem Assessment, which are central to the work of the Institute of Advanced Studies (UNU/IAS in Tokyo), as well as the work of the Programme for Biotechnology in Latin America and the Caribbean (UNU/BIOLAC in Caracas). UNU is particularly interested to further develop such activities in areas where specific countries have a great expertise which can be shared with developing countries for both individual and institutional capacity development.

It is now almost commonplace to stress the importance of learning and the accumulation of knowledge as critical factors in sustainable development. What is less widely recognized is the extent to which knowledge-intensity of production has extended beyond high technology sectors, such as information and biotechnology, to reshape a broad spectrum of traditional industries. Competition in all sectors has become more innovation-based. Innovation-based competition, as it diffuses around the globe through the process of market liberalization, challenges all enterprises to learn and to innovate. Competitiveness in these industries depends upon technological upgrading and capacity-building in products, processes, organization and management. For developing countries, upgrading in traditional industries provides an important area for accessing the benefits of new technologies. Both Iceland-based programmes on geothermal training and fisheries training fit perfectly in this philosophy and strategy. It

is UNU's Institute for New Technologies (UNU/INTECH in Maastricht) that focuses its work on new thinking and practical implementation strategies in the field of knowledge transfer to help develop the economies of developing countries. UNU's World Institute for Development Economics Research (UNU/WIDER in Helsinki), in relation to this, focuses its work on innovative approaches in development strategies in order to more efficiently and effectively alleviate poverty. The International Institute for Software Technology (UNU/IIST in Macao) helps develop software for development. Technology transfer is seen as a crucial contribution to the solution. However, it is a complex process involving investment in education and the building of technological capabilities in recipient countries to apply, adapt and assimilate technology in the productive sectors. The transfer and absorption of environmentally sound technologies is increasingly being recognized as critical to promoting sustainable development in developing countries. Yet "*technology transfer*" captures the reality of the largely one-way flow of developments in technology from the industrial to the developing countries. Even when technology transfer has been successfully completed, the developing countries have essentially been the consumers of technology, with industrial countries being the producers of new technology.

What makes the example set by the Geothermal Programme (UNU/GTP) so interesting, however, is that through its strategy of knowledge transfer, a worldwide community has been developed, a partnership, which allows for extensive exchange of information between such a large range of countries. In this way, working together has brought the ideal of learning from each other by working together, brought near to its realization.

Indeed, the Geothermal Training Programme (UNU/GTP) has been *setting the course* in the area of capacity development and knowledge transfer: within and beyond UNU. It was established in Iceland in 1978, not long after the UNU itself started its academic project activities in Tokyo in 1975. The goal of the Government of Iceland to contribute to the UNU in an area where Iceland commands particular experience and expertise matched perfectly with UNU's aim to assist developing countries in their efforts to enhance their capacities for development and governance. The positive impact that the Geothermal Training Programme has had over the past 25 years on the level of geothermal energy utilization in so many developing countries shows that this partnership has been most fruitful. UNU/GTP has pioneered many specific approaches in its capacity development efforts of which I will only single out three:

- An unique combination of theory and practice;
- The conscientious process of selection of participants;
- The combination of individual and institutional capacity development.

In these, and many other aspects, the UNU/GTP has set the course in capacity development within UNU. All those, who have been involved and those who will be in the future, can be congratulated with the results achieved. It is an example many experts engaged in capacity development outside UNU can benefit from.

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Twenty five years of geothermal training in Iceland

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Abstract

The first official statement on establishing a UNU geothermal institute in Iceland was made in 1975 when the United Nations University (UNU) had just been established. After a first proposal in 1976 and an international workshop in 1978, the Government of Iceland decided in October 1978 to ask Orkustofnun, the National Energy Authority (NEA), to sign an Agreement on Association with the UNU and establish the UNU Geothermal Training Programme (UNU/GTP). The first two UNU Fellows from the Philippines arrived in Iceland in May 1979. Since then, the UNU/GTP has held annual six month courses for professionals from developing countries. 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. 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 aim is to assist developing countries with significant geothermal potential in building up groups of specialists that cover most aspects of geothermal exploration and development. During 1979-2003, 300 scientists and engineers from 39 countries have completed the six-month courses, and over 80 have received shorter training. A MSc programme in geothermal science and engineering was opened in 2000 in cooperation with the University of Iceland. A second UNU training programme, the UNU Fisheries Training Programme (UNU/FTP), was established in Iceland in 1998, based on the experience of the UNU/GTP. Over 40 UNU Fellows from developing and transitional countries come annually to Iceland for specialized training at the UNU/GTP and UNU/FTP. In 2003, the Icelandic Government contributed about 1.7 million USD to the UNU activities in Iceland, thus covering about 90% of the total annual cost.

Key words: *Geothermal, training, Iceland, United Nations University, international cooperation.*

1 Introduction

The Charter of the United Nations University (UNU) was adopted by the UN General Assembly in 1973. The UNU commenced operations with headquarters in Tokyo in September 1975. Member countries of the UN were requested to support the establishment of the UNU. This could be in the form of contributions to the Endowment Fund of the UNU or through hosting individual research and training programmes at Associated Institutions. The Permanent Mission of Iceland to the UN supported the idea of establishing the UNU from the beginning, and considered in what way Iceland could best contribute to the work of the new university. The first official statement on establishing a UNU geothermal institute in Iceland was made by Ambassador Ingvi S. Ingvarsson in Tokyo at the Fourth Session of the UN Committee on Natural Resources in March 1975.

The Government of Iceland sent the first proposal on possible venues of cooperation to the UNU in Tokyo in January 1976. UNU Vice-Rector Walter Manshard and Dr. James M. Harrison visited Iceland in June 1976 for further discussions, and visited institutions, which might become Associated Institutions of the UNU. Initially, training programmes for both geothermal energy and fisheries technology were considered. The UNU showed preference for geothermal energy to

start with. It was considered whether the geothermal training centre should be hosted by the University of Iceland (UI) or Orkustofnun, the National Energy Authority (NEA), a government research institution with a large number of geothermal specialists, excellent laboratory facilities, drill rigs and logging equipment. After evaluating the available facilities, the UNU selected NEA.

A proposal to the UNU for the establishment of the Geothermal Training Programme in Iceland was adopted by the Government of Iceland in March 1978, and submitted to the UNU in Tokyo. The UNU convened an international workshop at Laugarvatn in Iceland in July 1978 to determine the need for the proposed training course and ensure that it would not duplicate courses already available. There were representatives of four UN agencies and geothermal specialists from El Salvador, Germany, Hungary, Iceland, India, Italy, Japan, Kenya, New Zealand, Philippines and the USA. The workshop concluded: "After consideration of the existing courses and that proposed by Iceland, it is concluded that they cover reasonably well the diversity of general and specialized requirements for training at the professional level. The Iceland course is regarded as an important addition to the existing programmes. It is urged, especially by participants from recipient countries, that the Iceland training programme for individuals be as short and flexible as possible while still adequately improving the knowledge and the skills of trainees. It is felt that preference should be given to candidates from those developing countries where geothermal exploration or development is under way, and to those who already have some practical experience in their own discipline" (United Nations University, 1979).

A detailed account of the preparations for UNU activities in Iceland is given in the proceedings of the 20th Anniversary Workshop of the UNU/GTP (Fridleifsson, 1998). In October 1978, the Government of Iceland decided to ask NEA to sign an Agreement on Association with the UNU. The Agreement on the Status of Association was signed in Tokyo on 27th December 1978, and on 13th February 1979 in Reykjavik. The first two UNU Fellows from the Philippines arrived in Iceland in May 1979. As of the end of the 25th annual session in 2003, 300 scientists and engineers from 39 countries have completed the six-month courses. This paper describes the operations of the UNU/GTP through the 25 years, and looks at the prospects for the near future.

2 Institutional environment and organization

The UNU/GTP (www.os.is/unugtp/) is operated at Orkustofnun, the National Energy Authority (NEA), which has been an Associated Institution of the UNU since 1978. Over half of the training and research of the UNU/GTP takes place at NEA, which is a government agency under the Ministry of Industry and Commerce. Its main responsibilities are 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. NEA has an excellent library specializing in energy research and development (in particular geothermal and hydropower), with some 12,000 titles, and subscriptions to 140 journals. The turnover of the NEA in 2002 was 12 million USD. In 2002, NEA published 80 research reports, and 100 scientific papers and abstracts by staff members were published in refereed journals and conference proceedings. UNU funds are, of course, not used for NEA research. The UNU Fellows, however, have full access to the research facilities and the multidisciplinary research environment of the NEA, which is one of the leading geothermal energy research institutions in the world.

Since 1997, the NEA has been divided into four independent units: the Energy Management Division (energy resources, statistics and analyses), the UNU Geothermal Training Programme (UNU/GTP), the Geoscience Division, and the Hydrological Service Division. NEA has a staff of about 110, whereof 77% are university graduates. Most of the teaching and research supervision of the UNU/GTP is conducted by geothermal specialists of the Geoscience Division. Of the 50 staff members of the Geoscience Division, 41 have university degrees, and 17 of these have Ph.D. qualifications. The disciplines are represented as follows: 16 geologists, 13 geophysicists, 5 chemists, and 4 engineers. The Geoscience Division has a chemical laboratory, geophysical laboratory, petrological laboratory, and three logging trucks for geothermal wells.

In 2003, as a result of changes in the energy legislation in Iceland, the Geoscience Division was separated from the NEA and a new government 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 the expertise of Iceland GeoSurvey internationally (www.isor.is). It is expected that about 20% of the annual turnover of ISOR will come from government contracts, and the remainder from contracts with various energy companies, utilities and municipalities. This is similar to the operations of the Geoscience Division in recent years. The new company will continue working on the same premises and with the same staff as the Geoscience Division. The UNU/GTP is on the same floor of the building. It is expected that the integration of the UNU Fellows with the specialists and the research atmosphere will continue as in previous years.

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 co-operation 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, which constitute 25% of the MSc programme.

The UNU/GTP has three permanent staff members (employed by NEA), but lecturers and support staff are hired from NEA, the UI, and other agencies/companies. Every year, about 50 staff members of these institutions render services to the UNU/GTP under specific contracts. This allows the flexibility required to provide highly specialized training in the nine fields of specialization offered.

The UNU/GTP is academically governed by a Studies Board, which is composed of experts (from NEA and UI) responsible for each of the specialized courses that are offered. In addition to the eight specialized courses offered from 1979, a new course in Environmental Studies has been operated since 1997. The present members of the Studies Board are Dr. Ingvar Birgir Fridleifsson (chairman), Dr. Kristjan Saemundsson (Geological Exploration), Dr. Hjalti Franzson (Borehole Geology), Dr. Knutur Arnason (Geophysical Exploration), Dr. Benedikt Steingrimsson (Borehole Geophysics), Dr. Gudni Axelsson (Reservoir Engineering), Dr. Halldor Armannsson (Environmental Studies), and Mr. Sverrir Thorhallsson (Drilling Technology) from NEA (now ISOR); Prof. Stefan Arnorsson (Chemistry of Thermal Fluids), and Prof. Pall Valdimarsson (Geothermal Utilization) from UI.

Dr. Ingvar Birgir Fridleifsson has been the director of the UNU/GTP from the beginning, except for one training season in 1981 when Dr. Hjalti Franzson served as director, and three training seasons in 1986-1988 when Dr. Jon Steinar Gudmundsson served as director. Mr. Ludvik S. Georgsson has been the deputy-director since 1990. Mrs. Gudrun Bjarnadottir has been the administrative assistant since 1996.

3 Contact with UNU headquarters

The agreement between the NEA and the UNU on the Status of Association initially signed in 1978 was renewed first at three year intervals and later at five year intervals. The agreement, which has been modified through the years, sets out the framework for the cooperation between the NEA and the UNU. Through the years, the operational contact has been between the UNU/GTP director and senior staff members at UNU headquarters in Tokyo. The main contact persons have been Dr. Walter Shearer (Senior Programme Officer 1979-1983), Dr. Aly Nazerali (Secretary of the UNU Committee on Training 1983-1985), Dr. Abraham Besrat (Training and Fellowship Officer and later Vice Rector 1986-1998), and Mrs. Wilma James (Training Assistant 1998-2003). The bulk of the cooperative work has been the selection of UNU Fellows for training, which involves site visits to the various countries, personal interviews with candidates (undertaken by UNU/GTP), the screening of applications, and the award of UNU Fellowships (undertaken jointly by the UNU and UNU/GTP). In the early days, all reports had to go by mail and short messages by telex. With the telefax in the mid 1980s and later the e-mail, communication has become much faster and easier. The cooperation has been very good through the years. Particular mention should be made of Dr. Abraham Besrat, who from 1986 to his untimely death in 2002 gave great support to the UNU/GTP, and was a key person in the establishment of the UNU Fisheries Training Programme (UNU/FTP (www.unuftp.is) in Iceland in 1998, which was modelled on the experience of the UNU/GTP.

The UNU/GTP director participated in meetings at UNU headquarters in Tokyo in 1979, 1980, 1981, and 1982. After that, visits to UNU headquarters became more sporadic (1987, 1991, but annually from 1995), and the operations handled mostly through correspondence. Several key persons from UNU headquarters have visited the UNU operations in Iceland through the years, including UNU Senior Adviser and former UNU Vice-Rector Walter Manshard (1980), UNU Programme Director Maurice Levy (1982), UNU Rector Gurgulino de Souza (1991, 1997), Dr. Abraham Besrat (1994, 1996, 1997, 1998), UNU Consultant Prof. Leon Gordenker (1998), UNU Programme Officer Dr. Birgit Poniatowski (2001), and UNU Rector Hans van Ginkel (1998, 2003). The UNU/GTP was also honoured by the visits of UN Secretary General Perez de Cuellar in 1983, UN Assistant Secretary General Margaret J. Anstee in 1985, and UN Under-Secretary General Mr. Nitin Desai in 2000.

Since 1998, at the invitation of Rector Hans van Ginkel, the UNU/GTP director has attended the annual meetings of the UNU Council and participated in the Conference of Directors (CONDIR) of the UNU (twice per year) representing the two UNU programmes in Iceland (UNU/GTP and UNU/FTP). A CONDIR meeting was held in Iceland for the first time in April 2003.

4 Geothermal training programme

The first annual training session of the UNU/GTP started in May 1979 with two UNU Fellows from the Philippines. Since then, a group of scientists and engineers from energy agencies and research organizations as well as universities in the developing

countries and Central and Eastern European countries, have come to Iceland every spring to spend six months in highly specialized studies, research, and on-the-job training in geothermal science and engineering. All of them are university graduates, generally with practical experience in geothermal work in their home countries. The training is tailor-made to the individual and the needs of his institution/country. In all, 300 participants from 39 countries have completed the six month courses during 1979-2003. They have come from Asia 45%, Africa 26%, Latin America 15% and Central & Eastern Europe 14%. To date, there have been 46 women in the group (15%). Table 1 shows the number of participants per country and the specialized courses they have taken.

Table 1: Fellows of the UNU/GTP 1979-2003 and specialization by country.

Country	Geolog. Explorat.	Borehole Geology	Geophys. Explorat.	Borehole Geophys.	Reservoir engineer.	Chem. of thermal fluids	Environm. studies	Geothermal utilization	Drilling technolo.	Tot.
Algeria	1					1		1		**3**
Bulgaria				1	2	2				**5**
Burundi	1									**1**
China		3	1	2	20	11	5	10	2	**54**
Costa Rica	2	2	2		2	1	1	1		**11**
Djibouti		1								**1**
Egypt		1			1	1				**3**
El Salvador	1	1	2	2	4	4	2	1	3	**20**
Eritrea			1							**1**
Ethiopia		3	3	1	4	3		4	2	**20**
Georgia								1		**1**
Greece			1					2		**3**
Guatemala		1			1	1				**3**
Honduras		1	1							**2**
Indonesia		3	3	2	3			1		**12**
Iran	1	3	1	1	1		1	2		**10**
Jordan				1	1	1		1		**4**
Kenya	1	4	7		5	6	5	1	4	**33**
Latvia								1		**1**
Lithuania					1			1		**2**
Macedonia						1				**1**
Mexico	1		1		2					**4**
Mongolia						1		3		**4**
Nepal						1		1		**2**
Nicaragua					3	1				**4**
Pakistan	1	1			1	1				**4**
Philippines		3	5	4	9	5		3		**29**
Poland		1		1	5	1		6		**14**
Romania								5		**5**
Russia				1	1	2				**4**
Serbia				1	1	1				**3**
Slovakia				1	1					**2**
Tanzania	1									**1**
Thailand		1		2		1		1		**5**
Tunisia					1			5		**6**
Turkey		1			1	3	1	3		**9**
Uganda	2	1	1			2				**6**
Ukraine					2					**2**
Vietnam	1		1		1	1			1	**5**
Total	**13**	**31**	**30**	**20**	**73**	**52**	**15**	**54**	**12**	**300**

The approximate time schedule of the Training Programme is shown in Table 2. The duration is 6 months. In general, all participants are expected to attend an Introductory Lecture Course that lasts 4-5 weeks (three lectures and a practical each day). The aim of the lecture course is 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 lecture course is followed by five weeks of specialized lectures and practical training in each of the nine specialized lines of training. A

description of the specialized courses can be found on the home page of the UNU/GTP (www.os.is/unugtp/).

Table 2: Time schedule of the UNU Geothermal Training Programme.

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	Field geology	Drilling	Resistivity methods	Course on well logging and reservoir		EIA Project planning	Sampling of fluids and gas		Drilling equipment
7	Maps and photos	Petrological logging	Thermal methods	engineering including:		Chemistry Physics	Scaling and corrosion		Drilling procedures
8	Structure analysis	Alteration	Magnetics	Logging and well testing practises		Biology Monitoring	Analytical methods	Heat transfer and	Well design Safety
9	Hydrogeology	Mineralogy	Gravity	Reservoir physics Reservoir simulation		Revegetation	Thermodynamics	fluid flow	Management
10				Tracer tests Computer programs		Health and safety	Geothermometers	Control systems	Rig operations
11 12	Excursion to the main geothermal fields of Iceland								
13	Field work in deeply	Aquifers	Data processing	Logging methods	Responses to	Gas dispersion	Water rock	Design of plants	Cementing
14	eroded strata	Modelling	techniques	Data evaluation	exploitation	and abatement	interaction	and systems	Completion
15									
16	Project	Project	Project	Project	Project	Project	Project	Project	Project
17	and	and	and	and	and	and	and	and	and
18	report	report	report	report	report	report	report	report	report
19 20 21 22 23 24 25 26									

Excursions are arranged to the main geothermal fields under exploration and utilization in Iceland. Seminars are held and case histories studied on each of the fields. Not only have many Fellows stated that these excursions and seminars have opened their eyes on how to undertake geothermal exploration and development, but also that the close company during the excursions has been the start of long lasting friendships between many of the Fellows. The latter half of the training period is devoted to individual research projects, which are concluded with extensive research project reports.

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. Each participant is meant to follow only one line of training (Table 2), but within each line there is considerable flexibility. A significant part of the practical training is done in connection with the research projects of the Fellows. The project topic is always selected with respect to the conditions of the home country of the participant. In many cases, trainees 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.

Many of the project reports are written in such a way that they serve as manuals for performing certain measurements, or applying interpretation methods dealt with in respective reports. 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” (edited by Ludvik. S. Georgsson) 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 are listed on the UNU/GTP home page (www/os.is/unugtp/).

The first PC-computer was bought for the Training Programme in 1982, and gradually computers have played an ever increasing part in the project work. All

participants receive training in using PC-computers for word processing, interpretation of data, as well as in using the Internet. Each of them is provided with a PC during their training in Iceland. Experience has shown that most trainees have access to PC-computers at home, and they can take their CDs home and continue the work there. Thus, there has been a considerable transfer of computer technology from Reykjavik to geothermal institutions in the developing countries. Participants having access to large computers at home are allowed to work on the Unix computer system at NEA.

All the participants are trained in using the Internet and encouraged to do so. 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 with the Internet. In August 2003, over 200 former UNU Fellows (out of 300) were 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. Interest groups in individual disciplines have not been set up formally, but many Fellows, in particular former classmates, consult each other as well as their colleagues (former teachers) in Iceland on technical matters.

5 Teaching materials

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, a special effort has been made to compile text material and manuals as teaching material for the training. The regular teachers of the UNU/GTP have done most of this work. Some texts have also been written by visiting scholars from other countries. Some of the teaching materials have been published in reports, and are available upon request. Examples include the texts on hydrogeology (Sigurdsson, 1987); petrology and mineral alteration (Reyes, 1998); environmental effects of geothermal utilization (Hunt, 2001); geophysical exploration and interpretation (Hersir and Björnsson, 1991; Arnason and Hersir, 1988); geothermal logging (Stefansson and Steingrimsson, 1981); reservoir engineering (Pruess, 2002); geochemistry (Fournier, 1989); geothermal district heating (Karlsson, 1982); and direct use of geothermal energy (Lund, 1996; Harrison, 1987). A few of the teaching texts are into their second and third editions.

One guest lecturer with an international reputation is invited every year as a UNU Visiting Lecturer to give a lecture series and to lead discussions with the trainees. The UNU Visiting Lecturers have stayed from about one week to two months in Reykjavik. Table 3 shows the UNU Visiting Lecturers 1979-2003. Many of the lectures of the UNU Visiting Lecturers have been published by the UNU/GTP, and are listed by author in the publication list of the UNU/GTP (www.os.is/unugtp). Copies of the publications are available on request.

Table 3: UNU Visiting Lecturers 1979-2003.

1979	Donald E. White	USA		1992	Patrick Muffler	USA
1980	Christopher Armstead	UK		1993	Zosimo F. Sarmiento (UNU Fellow 1980)	Philippines
1981	Derek H. Freeston	New Zealand		1994	Ladislaus Rybach	Switzerland
1982	Stanley H. Ward	USA		1995	Gudmundur Bodvarsson	USA
1983	Patrick Browne	New Zealand		1996	John Lund	USA
1984	Enrico Barbier	Italy		1997	Toshihiro Uchida	Japan
1985	Bernardo Tolentino	Philippines		1998	Agnes Reyes (UNU Fellow 1979)	Philippines / New Zealand
1986	Russel James	New Zealand		1999	Mike Wright	USA
1987	Robert Harrison	UK		2000	Trevor Hunt	New Zealand
1988	Robert O. Fournier	USA		2001	Hilel Legmann	Israel
1989	Peter Ottlik	Hungary		2002	Karsten Pruess	USA
1990	Andre Menjoz	France		2003	Beata Kepinska (UNU Fellow 1994)	Poland
1991	Wang Ji-yang	P.R. China				

6 Site visits and selection of participants

Specialized practical training is considerably more expensive than group training because of the high teacher-to-student ratio. On average, a full time teacher takes care of three students during the intensive training. The total cost of training per student in Reykjavik (including international travel and per diem) is about 30,000 USD. Much care is therefore taken in selecting the participants. The selection procedures of the UNU are adhered to, which involve site visits by representatives of the UNU/GTP to the countries of potential candidates, and personal interviews with all candidates. 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 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. The candidates should normally be under 40 years in age.

Participants from developing countries and most Central and Eastern European countries normally receive scholarships financed by the Government of Iceland and the UNU that cover international travel, tuition fees, and per diem in Iceland. The participants therefore do not need other funds for their training. The UNDP, the International Atomic Energy Agency (IAEA), as well as the European Union have also financed fellowships for several trainees through the years. Qualified participants from industrialized countries can also be accepted on the condition that they obtain similar scholarships from their own institutions/countries or other sources.

The site visits have played a very significant part in the work and in the success of the UNU/GTP. Since 1979, an average of 5-6 site visits have been conducted annually to countries requesting training, or a total of 138 visits. The site visits have been divided between the continents as follows: Africa (19%), Asia (38%), Central America (22%), and Europe (21%). The highest number of visits have been to China (15), Kenya (10), Philippines (9), El Salvador (8), Costa Rica (8), and Ethiopia (6). The visits have been made by the permanent staff of the UNU/GTP (66%), members of the Studies Board (22%), and other geothermal specialists (12%), mostly from NEA.

The director or the deputy director normally undertake the first site visit to a given country. In addition to visiting geothermal fields, research institutions, and interviewing candidates, the UNU/GTP representatives commonly participate in local or regional geothermal energy conferences/seminars, and in some cases give lectures or lecture series at selected institutions and universities. Indeed, many site visits are planned to coincide with regional conferences and seminars. In many cases, members of the Studies Board and other specialists from the NEA spend a few extra days in a given country/continent to make site visits for the UNU/GTP when they are travelling to conferences or on consultancy missions. In this way, the travel cost can be shared.

The site visits are extremely valuable for the quality of the training. The private interviews with candidates are aimed to secure the quality of the selected Fellows. During the 25 years, only seven UNU Fellows 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.

7 Building of specialist groups and evaluation

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 1 shows the number of Fellows completing the six month specialized training per year during 1979-2003. The number of Fellows has gradually increased and mostly been controlled by available financing. There have always been waiting lists of qualified candidates. In the last few years, there have been 16-20 Fellows graduating per year.

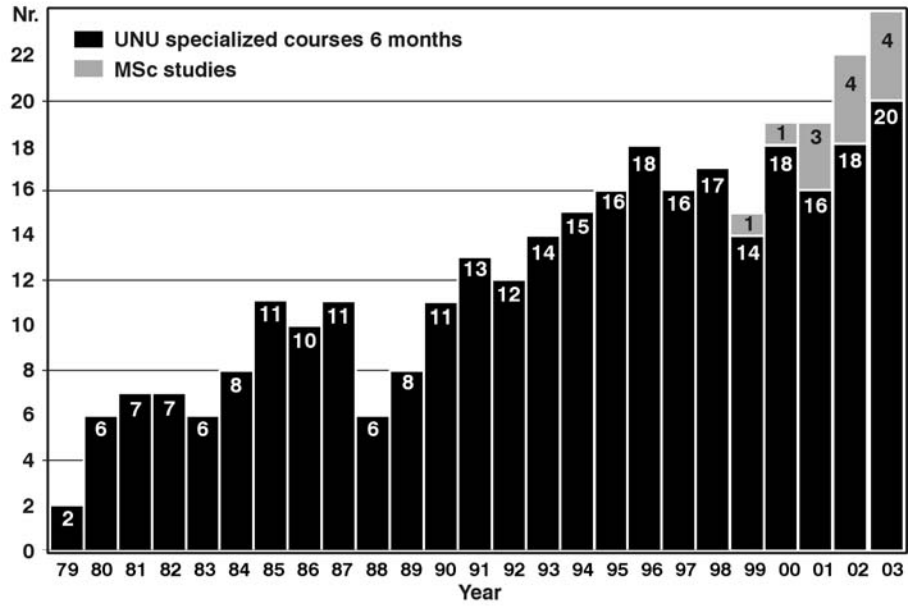

Figure 1: Number of Fellows completing six month courses and studying for a MSc 1979-2003.

Table 1 lists the countries of origin of the participants who have completed the six-month training during 1979-2003, and their specialized courses. The largest groups have come from China (54), Kenya (33), Philippines (29), El Salvador (20) and Ethiopia (20). Eleven other countries have sent 5-14 participants.

Table 4 shows how the leading recipient countries have sent professionals for specialized training in most of the courses offered. Relatively few experts have been trained in geological exploration and drilling technology, as these subjects are generally mastered in the home countries.

Table 4: Number of Fellows from the five leading countries and their chosen specializations 1979-2003.

	China	Kenya	Philippines	El Salvador	Ethiopia
Geological Exploration		1		1	
Borehole Geology	3	4	3	1	3
Geophysical Exploration	1	7	5	2	3
Borehole Geophysics	2		4	2	1
Reservoir Engineering	20	5	9	4	4
Chemistry of Fluids	11	6	5	4	3
Environmental Studies	5	5		2	
Geothermal Utilization	10	1	3	1	4
Drilling Technology	2	4		3	2
Total	54	33	29	20	20

The UNU/GTP has two times been evaluated as a part of the UNU system. In 1996, a detailed account was given within an assessment report on UNU training and fellowship activities (United Nations University, 1996). In 1998, a brief description was given within a report on the 20-year review and evaluation of the UNU (United Nations University, 1998). Both evaluations were very favourable to the UNU/GTP.

Internal assessment of the training has, in the past, mainly taken the form of interviews with former trainees and their directors. A representative of the UNU/GTP visits the main recipient countries every few years, and meetings are also arranged in connection with international geothermal conferences. Some changes have been made

in the detailed contents of some of the specialized courses, based on the feedback from the trainees and their institutions. During the training, questionnaires (anonymous answers) are also used to obtain the opinion of the Fellows on the content of the lectures and the performance of the lecturers. In 2002, a special evaluation was made of the Introductory Lecture Course (see Table 2). A member of the Studies Board (Dr. Knutur Arnason, senior geophysicist of NEA) sat through most of the lectures of the five-week course. He wrote a report with recommendations on the overall balance of the course, and made specific recommendations on improving lectures in the different subjects.

In preparation for the present conference, former UNU Fellows were asked to write papers on the contribution of UNU/GTP training to geothermal development in Africa, Asia (without China), Central America, Central and Eastern Europe, and China (Mwangi, 2003; Benito and Reyes, 2003; Barrios, 2003; Kepinska, 2003; Zhao et al., 2003 respectively – this volume). 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. All the participants are selected after private interviews conducted by staff members or part-time teachers of the UNU/GTP, 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. A number of the Fellows from the first years of training have gone into retirement.

Since 2000, a few former UNU Fellows have been admitted to a MSc programme in geothermal science and engineering in cooperation with the University of Iceland. 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 fulfill 25% of their MSc programme credit requirements. The first UNU Fellow to attend the MSc programme in geothermal engineering was Mr. Muthafar Emeish from Jordan (UNU Fellow 1999). He graduated in 2001.

The aim of establishing a MSc programme in cooperation with the UI is to go a step further in assisting selected countries in building up their specialist groups. Two scientists from Kenya started their MSc studies in January 2001, and graduated in 2002. One of them (UNU Fellow 1996) conducted research on the reservoir engineering aspects of the Olkaria geothermal field in Kenya, the other (UNU Fellow 2000) wrote his MSc thesis on the chemistry of the same field. Two Kenyans commenced their MSc studies in 2002; one (UNU Fellow 2001) is working on the environmental aspects, and the other (UNU Fellow 1995) on the geology and alteration mineralogy of the Olkaria field. Kenya is the leading country in geothermal research and development in Africa, and most of the geothermal specialists have been trained in Iceland. With the advanced training of the MSc students, the UNU/GTP is assisting Kenya in bringing geothermal research to a still higher level. It is hoped that, in the future, Kenya will be in a position to assist neighbouring countries by training some of their scientists and engineers. At present, Kenya obtains about 9% of its electricity from geothermal energy. The government plans to increase this figure to 20-25%. The UNU/GTP will support this aim.

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 total installed geothermal electric capacity in the world was about 2,800 MWe when the UNU/GTP was established. Today, the installed capacity is about 8,000 MWe. A part of this growth is in countries where former students are key geothermal specialists. Many former students are also key specialists in the direct use of geothermal energy for the purpose of heating houses. In this respect, particular mention can be made of China and countries in Central and Eastern Europe, where great progress is being made in replacing the use of coal for house heating with environmentally clean geothermal energy.

8 International cooperation

One of the roles of the UNU/GTP, according to the Agreement on the Status of Association with the UNU, is to "develop and maintain communication among developing countries and arrange, as necessary and appropriate, conferences, seminars, workshops and panels which would further the dissemination and application of practical knowledge" in geothermal energy. This has been fulfilled partly by direct cooperation with the UNU/GTP alumni and their institutions, and partly through active participation in international geothermal conferences, workshops, and seminars. The UNU/GTP has contributed to the organization of many international meetings such as the *1985 International Symposium on Geothermal Energy* (US Geothermal Resources Council, Hawaii 1985); *UN Workshop on the Development and Exploitation of Geothermal Energy in Developing Countries* (with UN/DTCD in Reykjavik 1986); the *World Geothermal Congress 1995* (International Geothermal Association, Italy 1995); and the *World Geothermal Congress 2000* (International Geothermal Association, Japan 2000).

Former UNU Fellows have also been active with their colleagues in some countries in arranging regional and international conferences/workshops such as the annual *PNOC-EDC Geothermal Conference* in the Philippines; the *European Summer School on Direct Applications of Geothermal Energy* (sponsored by the European Commission and the International Geothermal Association, at Oradea University, Romania 2001); the *International Scientific Conference on Geothermal Energy in Underground Mines* (Poland in 2001); the *2002 International Symposium on Geothermal at the 2008 Olympics in Beijing*; and the *KenGen Geothermal Conference* in Kenya 2002, which was expanded in 2003 under the title *2003 Eastern Africa Market Acceleration Conference*. The UNU/GTP has been very active within the International Geothermal Association (IGA), with the director serving as Chairman of the European Branch of IGA 1992-1995, and as IGA President 1995-1998. Many former UNU Fellows are active members in the respective national geothermal associations (which are affiliated with the IGA) and three (from Ethiopia, Kenya and Romania) are on the present Board of Directors of IGA.

The most memorable participation of UNU Fellows in the international arena was the *World Geothermal Congress 2000* in Japan. The Congress is organized every five years by the IGA, this time with the Japanese Organizing Committee (an assemblage of Japanese government institutions, technical societies and companies) as a Co-Convenor. There were about 1,250 participants (plus over 100 accompanying members) from 61 countries. The proceedings of the Congress (published on CD-ROM as well as in hardcopy) include 670 technical papers. These were presented in oral and poster sessions.

Fellows trained at the UNU/GTP in Iceland during 1979-1999 were authors or co-

authors of 85 technical papers at the Congress. Out of the total of 227 Fellows who had completed the six month courses in Iceland, 61 from 24 countries attended the Congress and presented papers. Among these were 14 women. The former Fellows came from Bulgaria (4), China (14), Costa Rica (2), Egypt (1), El Salvador (2), Ethiopia (3), Guatemala (1), Indonesia (3), Iran (3), Jordan (1), Kenya (5), Lithuania (1), Macedonia (1), Mexico (1), Nepal (1), Pakistan (1), Philippines (6), Poland (2), Romania (4), Serbia (1), Slovakia (1), Tunisia (1), Turkey (1), and Uganda (1). Many of them presented the country papers for their respective countries and were, in some cases, the only representatives of their countries. The Fellows presented a total of 41 papers orally and 44 posters. They made a very significant contribution to the Congress, and their participation has certainly strengthened the position of their respective institutions/countries in international geothermal cooperation.

A reunion was held for the UNU Fellows, members of the Studies Board and teachers/instructors of the UNU/GTP, as well as for several UNU Visiting Lecturers who have taught at the UNU/GTP through the years (see Figure 2). It was a great occasion where former classmates met who were trained in Iceland as much as twenty years ago, and who presently are among the leaders of geothermal development in their respective countries. A similar reunion was held at the *World Geothermal Congress 1995* in Florence (Italy) where 35 former Fellows (out of 161 graduates) attended and presented papers. The next World Geothermal Congress will be held in Turkey in 2005.

Figure 2: Fellows trained at the UNU Geothermal Training Programme (UNU/GTP) in Iceland during 1979-1999 were authors or co-authors of 85 technical papers at the World Geothermal Congress 2000 in Japan. Out of a total of 227 Fellows who had completed the six month courses in Iceland, 61 from 24 countries attended the Congress and presented papers. The photo shows the Fellows with the UNU Rector, the director, and a few instructors of the UNU/GTP.

Through the years, the director of the UNU/GTP has frequently been asked to represent geothermal energy in international working groups and at conferences, as the UNU/GTP is the most active UN centre dealing with geothermal energy at present. Two recent examples can be mentioned: An invitation to be the lead author of the chapter on geothermal energy of the *World Energy Assessment Report* (WEA, 2000) prepared by UNDP, UN-DESA, and the World Energy Council (WEC), as an

input to the session on energy and sustainable development of the UN Commission on Sustainable Development in April 2001, at the UN in New York; and an invitation to give a paper on geothermal energy opportunities in Africa to the *Twenty-first Session of the Governing Council of UNEP* and the *Second Global Ministerial Environment Forum* in Kenya, in February 2001.

9 Financing of UNU activities in Iceland

During 1979-1982, the financing of the UNU/GTP was shared equally by the UNU and the Government of Iceland. Since then, the Government of Iceland has carried the lions share (80-90%) of the annual financing. Through the years, international agencies such as UNDP, the IAEA, and EFTA /EU (Brussels) have occasionally financed Fellowships. These have both been for six months and shorter training periods. Fellowships awarded by UNU/Iceland have only been for six month training, apart from a few UNU Special Fellowships for senior scientists for short visits in the early years of the UNU/GTP. Over eighty people have come for short training and study visits (2 weeks to 4 months) during 1979-2003, in addition to the 300 who have completed the six-month training courses.

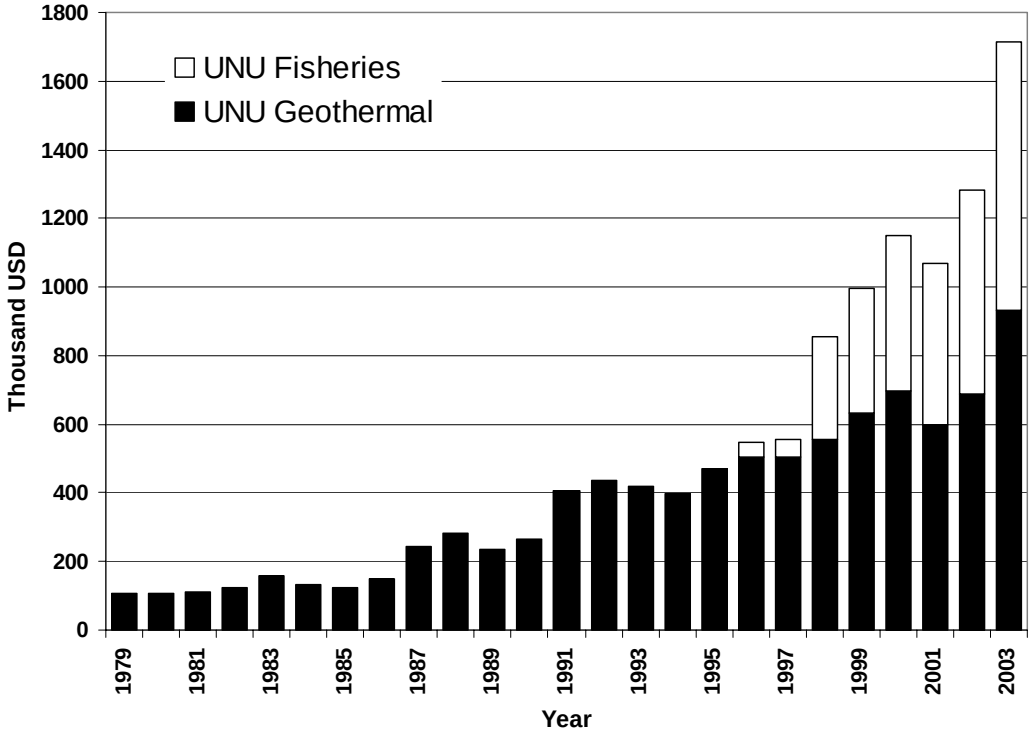

Figure 3: Annual contribution of the Government of Iceland to the UNU programmes in Iceland (UNU/GTP and UNU/FTP) in 1979-2003 in thousands USD.

The UNU Fisheries Training Programme (UNU/FTP) started operating in Iceland in 1998 on the basis of an Agreement on Cooperation between the UNU, the Government of Iceland, and the Marine Research Institute. The training methods and mode of selection of participants is based on the experience of the UNU/GTP. Under the able leadership of Dr. Tumi Tomasson, the director, in five years the UNU/FTP (www.unuftp.is) has grown in size similar to the UNU/GTP. A total of 62 Fellows from 19 countries have graduated from the Programme during 1998-2003. The demand for training in fisheries studies is expected to be larger than in geothermal energy since more countries are highly dependent on fisheries than geothermal

energy. Six specialized courses are offered: Quality Management of Fish Handling and Processing; Fisheries Policy and Planning; Marine and Inland Waters Resources Assessment and Monitoring; Fishing Technology; Management of Fisheries Companies and Marketing; and Aquatic Environmental Assessment and Monitoring. There are plans to initiate a MSc programme at the UNU/FTP in the near future, in cooperation with the University of Iceland.

The Government of Iceland has been very supportive of the UNU activities in Iceland through the years. Figure 3 shows the contribution of the Icelandic Government to UNU activities in Iceland 1979-2003. The total contribution to the UNU/GTP amounts to 9.3 million USD, and to the UNU/FTP during 1996-2003 about 3.1 million USD. In 2003, the total Government contribution to the UNU activities in Iceland amounts to 1.7 million USD. The financial contribution from UNU headquarters is confined to Fellowships and amounts to 100 thousand USD per year to each programme.

The annual contributions are decided in the annual State Budget. The payments for the UNU/GTP go directly to NEA. All accounting is kept separate for the UNU/GTP at NEA. The National Audit Office of Iceland audits the accounts annually. The annual contribution from the Government to the UNU/FTP is paid to the Marine Research Institute. The National Audit Office of Iceland audits the separate accounts for the UNU/FTP annually.

10 Future prospects

Looking back over 25 years of operations certainly gives cause for reflection on whether an international school is on the right track. The UNU/GTP was established in the shadow of the oil crisis, when many nations were looking for new and renewable energy sources in order to reduce their dependence on the hydrocarbons, in particular oil with its rapidly escalating prices. At the beginning of the new century, the situation is somewhat similar in that the international community is looking towards the new and renewable energy sources as an alternative for the hydrocarbons (especially coal and oil) in order to reduce the emissions of greenhouse gases. The total world electricity production from renewables in 1998 was 2,826 TWh. By far, the largest contribution (92%) came from hydropower, but 5.7% from biomass, 1.6% from geothermal, and 0.6% from wind (WEA, 2000). The electricity production from solar energy constituted only 0.05%, and from tidal energy 0.02%. The current energy cost is lowest for hydropower and geothermal, followed by biomass and wind. Solar photovoltaic electricity is by far the most expensive. The potential role of geothermal is also significant on the world scale in the heating of houses, thus reducing the dependence on polluting coal and oil for space heating.

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 the 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.

The UNU/GTP has, through the years, kept in good contact with the other three international geothermal schools which were established in Italy (Pisa in 1970), Japan (Kyushu in 1970), and New Zealand (Auckland in 1978). Unfortunately, the Pisa

school has not held its annual course since 1993 due to drastic cuts in government financing; the International Group Training Course at Kyushu University was closed in 2001; and the Diploma course at Auckland University has also been closed in 2003 for the same reason, hopefully only temporarily. 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. The UNU/GTP is thus at present the only international graduate school offering specialized training in all the main fields of geothermal science and engineering.

No major changes are planned in the operations of the UNU/GTP at present. Through the years, there has been a steady flow of requests from all over the world for the six-month specialized training, and it has been possible only to meet a portion of the requests. With the closing of the geothermal schools in Kyushu and Auckland, the number of applicants will probably rise. Although the MSc programme has now commenced, the main emphasis will be on the six month highly specialized courses. In the coming five years, it is expected that the UNU/GTP will have about 20 Fellows per year for the six month courses, and that the MSc programme will be expanded, admitting up to five former UNU Fellows per year to commence MSc studies in geothermal science and engineering in cooperation with the University of Iceland. The UNU/GTP will thus continue to focus mainly on specialized training and capacity building. New countries will be added, but care will be taken not to spread efforts too thin. After 25 years of operations, experience strongly suggests that to make technology transfer successful and sustainable, it is necessary to build up a group of at least ten geothermal specialists in a given country. In addition, support will continue to former UNU Fellows in different countries/regions through the Internet and by site visits and seminars.

At the *UN World Summit on Sustainable Development* in Johannesburg in 2002, the Government of Iceland expressed interest in participating in the Renewable Energy Efficiency Partnership (REEEP) initiative. In his speech, the Prime Minister of Iceland made special reference to further development assistance from Iceland through training in the fields of geothermal energy and fisheries research. Tentative plans have been made for the UNU/GTP to set up travelling short courses in geothermal development in selected African countries within the framework of the REEEP. This would require special funding from the Government of Iceland, additional to the present funding of the UNU/GTP.

In preparation for the present conference, former UNU Fellows have been asked to write papers on the contribution of UNU/GTP training to geothermal development in Africa, Asia (without China), Central America, Central and Eastern Europe, and China (Mwangi, 2003; Benito and Reyes, 2003; Barrios, 2003; Kepinska, 2003; Zhao et al., 2003, respectively). The various recommendations made in these papers will be carefully considered in the planning of future 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 UNU/FTP, are hosted in Iceland. Both of these specialities are of national importance, since approximately 60% of the export earnings of Iceland come from fish products, and over 50% of the total primary energy is provided by geothermal energy. About 70% of the total primary energy of Iceland is provided by renewables (geothermal and hydropower). Oil (imported) is almost exclusively used for the transport sector (cars, ships, airplanes). 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 wants to share its experience with the developing and transitional countries. The Government considers the UNU a most suitable venue for channelling a considerable part of its multilateral development aid. The feedback from the recipient countries has been very favourable. It is commonly stated in public debate in Iceland that the research and training activities in cooperation with the UNU are the most effective development aid undertaken by Iceland. Public opinion polls show the same.

At the Opening Ceremony of the 25th session of the UNU/GTP in April 2003, the Foreign Minister of Iceland, Mr. Halldor Asgrimsson, addressed the future developments of UNU activities in Iceland as follows:

"Allow me finally to use this opportunity to share with you some of the future ideas we have for our UNU programmes in Iceland. During the last eight years, the Icelandic Government has almost doubled its contributions to development assistance. We regard our UNU programmes, the Geothermal Training Programme and the Fisheries Training Programme, as some of the best development projects we support. We believe that Iceland can contribute in both fields and possibly other fields as well. Iceland has, over the years, devoted considerable time and resources into developing the utilisation of renewable natural resources. We are willing and also proud to be able to share our know-how and expertise with you. We are now considering whether we need to reorganise and possibly expand the UNU programmes in order to strengthen their position in our own institutional structure and at the same time to give them higher profile within the UN system. New institutional arrangements could be key to that intention. I have therefore decided to set up a working group to further develop new ideas that have been brought to our table. Based on its recommendations, a final decision will be taken. I believe there is a momentum now to strengthen our support to the UNU and at the same time make better use of our own resources."

With these encouraging words as a guideline, the UNU programmes in Iceland will continue to look at how they can best assist in the transfer of technology on the sustainable use of natural resources to the developing and transitional countries. The experience of the 25 years of the UNU/GTP, and the 5 years of the UNU/FTP shows that the close involvement of the specialists of the leading research and development institutions of the country, in the respective activities of the UNU programmes, is an important key to successful operations in the future.

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