

The Contribution of the GRÓ Geothermal Training Programme in Iceland to Geothermal Capacity Building in Developing Countries

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GRÓ Geothermal Training Programme, ICELAND

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ABSTRACT

The Geothermal Training Programme (GTP) in Iceland has been in continuous operation for more than 4 decades, specializing in capacity building in all aspects of geothermal research and development for developing countries with geothermal potential. Since 1979 its core activity has been the operation of a 6-month training programme in Iceland. Up to 2021, 745 fellows from 64 countries have graduated from the programme. Since 1998 the GTP has also supported outstanding 6-month fellows for further studies at universities in Iceland, beginning with MSc-studies and adding PhD-studies to the roster in 2008. Since then, 75 students have completed MSc-studies and 4 PhD-studies, with GTP support. Since 2005 GTP has offered short courses or workshops in other countries, both on a regular basis such as in Kenya and El Salvador, as well on the basis of specific needs. Thus, an even larger audience has been reached with close to 2500 participants having benefitted from participating in 74 events. The benefit of GTP's capacity building is clearly witnessed by the progress of individual fellows, many of whom having become leading experts in their home countries, by advances in geothermal development in many supported countries as well by appraisals performed.

1. Introduction

The Geothermal Training Programme (GTP) in Iceland started operating in 1979, more than 4 decades ago, specializing in capacity building in all aspects of geothermal research and development for developing countries with geothermal potential. For most of its existence the GTP was affiliated with the United Nations University but since the beginning of 2000 it operates under GRÓ, International Centre for Capacity Development, Sustainability and Societal Change, along with its 3 Icelandic sister programmes (<https://www.grocentre.is/gro>), namely the Fisheries Training Programme (FTP), the Land Restoration Training Programme (LRT) and the

Gender Equality Studies & Training Programme (GEST), under the auspices of UNESCO. Most of GTP's activities have been financed by the Government of Iceland, while a small part has been additionally financed through international support, or by local companies.

The GTP was founded in 1978 and started operating in 1979, on a quite small scale, with two fellows receiving comprehensive training for close to six months. Since then this six-month training has been the core activity of the programme and has been operated on a yearly basis every year, except in 2020 when it had to be postponed due to covid. During the approximately first three decades of the programme's operation it grew, both in size (number of trainees) and activities, as will be discussed below. During the last decade or so the operation has been more stable.

The main purpose of the GTP can be summarized as follows:

- To assist developing nations with significant geothermal potential to build up geothermal expertise to be able to develop these important renewable energy resources for the benefit of its people.
- To provide university graduates engaged in geothermal work with intensive on-the-job training in their chosen field of specialization.
- To enhance the skills of the fellows by working side by side with geothermal professionals in Iceland.
- To tailor-make the training for the individual and the needs of his institution and country.

The main activities of GTP at present are:

- 1) Six-month training in Iceland of approximately 25 fellows yearly.
- 2) Fellowships for MSc- and PhD-studies at University of Iceland and Reykjavík University.
- 3) Short courses abroad in support of the United Nation's Sustainability Development Goals (SDG's).
- 4) Support for Diploma Course in El Salvador and for other comparable training programmes (e.g. in Kenya and China).
- 5) Other training activity, including customer designed courses and individual training.

Each of these will be specifically described in more detail below.

Dr. Ingvar B. Fridleifsson was the founding Director of GTP and served as such until his retirement in 2013. Dr. Jón S. Gudmundsson was acting director for three years during 1986 – 1989, however, and Dr. Hjalti Franzson during a brief period in 1981. Lúdvík S. Georgsson took over as Director in 2013, having been Deputy Director since 1990, holding the position to the end of 2019. The first author of this paper has been the Director of the GTP since January 1st, 2020.

For the first 42 years the GTP was operated at Orkustofnun, the National Energy Authority of Iceland. It is now operated at Iceland GeoSurvey (ÍSOR) under a contract with the Ministry for Foreign Affairs in Iceland, through GRÓ mentioned above. ÍSOR is a research institute focusing on all aspects of geothermal resource exploration and development, hence ideally suited as a cooperative partner for the GTP. In addition to the director, the GTP employs 3-4 full time staff members. The academic activities of the programme are governed by an 8-member Studies

Board and annually about 80 – 100 lecturers and support staff are hired from Iceland’s leading geothermal institutes, universities, engineering companies or energy companies in line with the needs of the programme and its trainees at any given time. This pool of expertise constitutes the programmes resource base and greatest asset.

The covid-19 pandemic has affected GTP operations the last couple of years. In addition to the postponement of the 2020 six-month training, all in-person training activities abroad were cancelled in 2020, and again in 2021 with the exception of SDG Short Course V in Kenya (see later), which was successfully held in November 2021. The pandemic has, however, accelerated the development of on-line training activities (see below), enlarging the audience reached by GTP greatly.

This paper briefly describes the different activities of GTP at present and its role in geothermal capacity building in developing countries during the last four decades. For more details the reader is referred to recent papers by Georgsson et al. (2021) and Haraldsson et al. (2021), as well as the webpage of the programme (<https://www.grocentre.is/gtp>).

2. Six-month Training in Iceland

Since its commencement, the core activity of GTP has been the operation of the six-month training programme in Iceland, as already noted. In addition to general geothermal education, each of the fellows receives specialized training along one of eight lines of specialization on offer;

- geothermal geology,
- geophysical exploration,
- reservoir engineering and borehole geophysics,
- chemistry of thermal fluids,
- drilling technology,
- geothermal utilization,
- environmental science, and
- project management and finances.

Finally, each fellow completes a twelve-week research project under the guidance of an Icelandic geothermal expert or experts.

Introductory lectures on all aspects of geothermal research and development continue for four weeks at the beginning of the six-month programme. Included in that part of the programme are a few fieldtrips to geothermal locations near Reykjavík and short lectures by the fellows on geothermal in their home countries. This is followed by work on a group project, lasting 10 days. Consequently, the group of fellows is split into 4 – 5 smaller group, each of which attends a specific line of specialization. This specialized training lasts for eight weeks but is broken up by a five-day field trip through the west and north of Iceland during which numerous sites of geothermal interest (high- and low-temperature resources as well as direct utilization and electricity generation) are visited. The last phase of the six-month program, lasting 11 – 12 weeks, is devoted to the individual research project. These are increasingly projects based on data from the fellow’s home-countries, thus not only benefitting the education of the fellows but also geothermal development at home.

Figure 1 presents the graduation statistics of GTP, both the number of six-month fellows per year and active MSc- and PhD-fellows (see Section 3 for a description of the MSc and PhD program). Up to 2021, 745 fellows from 64 countries have completed the six-month training. The home-countries of the fellow are presented in Figure 2.

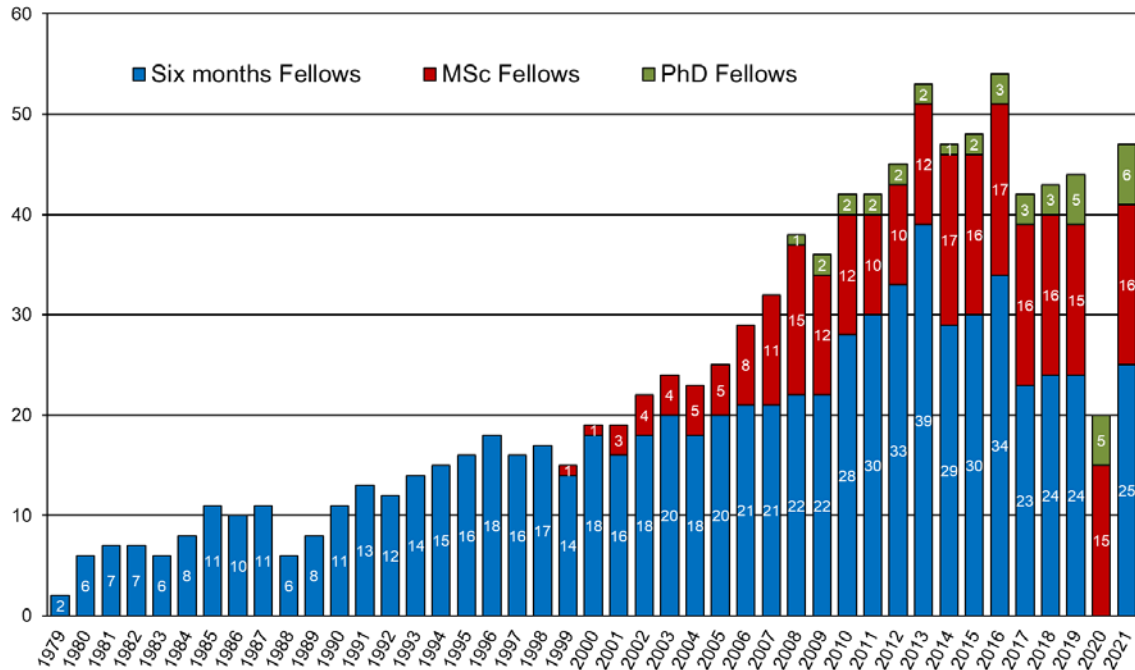


Figure 1: Yearly statistics for the number of active GTP fellows, both six-month fellows (blue) and MSc- (red) and PhD-students (green) supported by GTP.

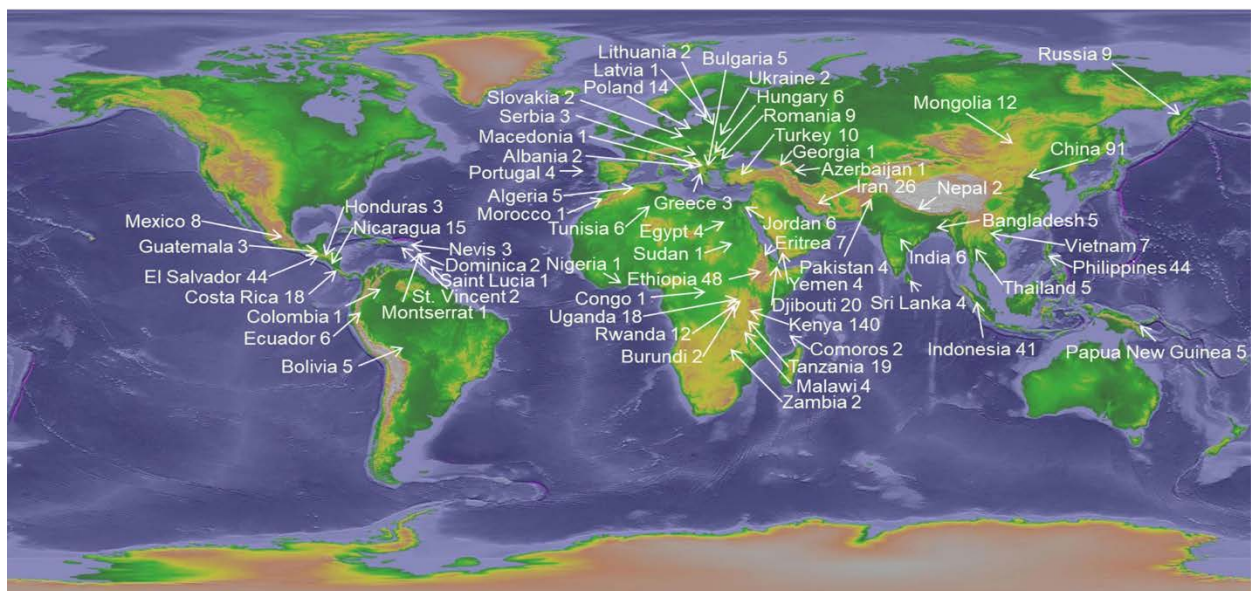


Figure 2: The 64 home-countries of 1979 – 2021 six-month fellows of the GTP along with the number of fellows per country.

Finally, it should be mentioned that the final project reports of the six-month fellows constitute an important part of the worldwide geothermal literature. They often present results of studies at workshops and conferences that add to the advancement of knowledge on geothermal resources in various parts of the world (see map in Figure 2). These are accessible through the GTP's webpage (<https://www.grocentre.is/gtp/publications>) along with MSc- and PhD-theses of fellows supported for further studies by GTP (see next chapter) and various papers written in conjunction with GTP's short-courses and workshops abroad (see chapter 4).

3. Support for MSc- and PhD-Studies

Since 1998 the GTP has also supported outstanding 6-month fellows for further studies at universities in Iceland, beginning with MSc-studies and adding PhD-studies to the roster in 2008 (see Figure 2 for the number of active MSc- and PhD-fellow per year). Since then, 75 students have completed MSc-studies and 4 PhD-studies, with GTP support.

The GTP has active agreements regarding these studies with both of the main universities in Iceland, i.e. the University of Iceland (UI, see <https://english.hi.is/>) and Reykjavík University (RU, see <https://en.ru.is/>). The agreement with UI was signed in 2000 and the one with RU in 2013. The agreements include the provision that the previous six-month training can be used to fulfil 25% of the requirements for an MSc degree, being equivalent to up 30 ECTS-units. The MSc- and PhD- fellowships provided by GTP cover costs associated with living and studying in Iceland, and Reykjavik University provides a fees scholarship.

Recently, about 4 – 5 MSc-fellowships are awarded per year along with 1 – 2 PhD-fellowships. The first GTP PhD-fellow, Dr. Pacifica F.A. Ogola, defended her PhD-thesis at the University of Iceland in 2013.

4. Short Courses and Workshops

Since 2005 GTP has offered short courses or workshops in other countries, both on a regular basis such as in Kenya and El Salvador, as well on the basis of specific needs. Thus, an even larger audience has been reached with a total of close to 2500 participants having benefitted from participating in 74 events up to early 2022.

This started out with a short course series supporting the UN Millennium Development Goals (MDGs) beginning in 2005 in Kenya to benefit African countries. A similar series was started in 2006 in El Salvador to benefit Latin American and Caribbean countries. A workshop for decision makers on direct use of geothermal resources was, consequently, held in China in 2008 for Asian countries. The Short Course series in Kenya and El Salvador were overhauled in 2016 in support of the UN Sustainable Development Goals (SDGs). Close to 1538 participants have benefitted from the 29 Short Courses and Workshops dedicated to the UN Development Goals over the period 2005-2021.

The short courses in Kenya, which have been jointly operated by GTP as well as KenGen (Kenya Electricity Generation Company) and GDC (Geothermal Development Company) in Kenya, have focused on geothermal exploration, this being deemed the most beneficial for the region up to now. The short courses in El Salvador, which have been conducted in cooperation

with LaGeo, have in contrast been focused on variable focus topics. Only one short course has been conducted in Asia so far, but GTP has the future goal of conducting short courses on a regular basis in Asia as well.

Since 2010, GRÓ GTP has offered tailored training on demand. These trainings have varied in topics, target groups and duration and have been financed by various bodies, including the Ministry for Foreign Affairs in Iceland, different power companies and international funding agencies. Forty-five workshops, short courses and extended training programmes had been conducted in four continents at the end of 2021, benefitting nearly 938 participants.

Since 2013, GRÓ GTP has contributed to a geothermal Diploma Course run within the academic framework of the University of El Salvador, first in an advisory role (2013-2015) and later as an implementing partner (2016-). The Course programme has greatly increased the possibilities for aspiring Latin American geothermal professionals to obtain dedicated training in the geothermal disciplines in their native tongue. Likewise, the African Geothermal Centre of Excellence (AGCE) has been gaining momentum in recent years. GRÓ GTP has had an advisory role in its conceptualization and conducted one of two opening short courses under the interim phase in cooperation with local partners in 2017. In November 2019, GTP contributed to the 5-week-long Sino-Icelandic Training Programme in Beijing, China.

The covid-19 pandemic has affected GTP operations in recent years, as already mentioned. The pandemic has accelerated GTP's experimentation with online training, with 4 such activities organized up to early 2022. It is expected that online training will become yet another pillar of GTP training activities, complementing other modes of training and expanding GTP's audience.

5. Benefits of GTP's Activities

The benefit of GTP's capacity building is clearly witnessed by the progress of individual fellows, many of whom having become leading experts in their home countries, by advances in geothermal development in many supported countries as well by appraisals of the programme performed.

Usually, support and development cooperation are evaluated objectively in terms of numbers. In energy related matters this can e.g. be in terms of megawatts or number of power plants. As a case in point for GTP one can take Kenya as an excellent example, where installed geothermal electricity generation capacity increased from 594 MWe in 2015 to 1193 MWe in 2020 (Huttrer, 2021), mostly through power plant installation in the Greater Olkaria Geothermal Area by KenGen. GTP has actually provided six-month training for 140 fellows from Kenya during the last four decades, the majority of which has come from KenGen.

Such numerical evidence does not grasp the full success, reach and results of the training. A subjective approach is needed in addition to capture these. The trainees who obtain a fellowship to come to Iceland, gain access to the Icelandic geothermal sector and local experts, many of whom are world leaders in their field with a vast experience from Iceland's long history of utilizing geothermal resources. But equally as important they also gain access to each other as they are themselves experts in their fields, with experience they can share with both other fellows and teachers. The training, therefore, provides a unique venue where this interactive knowledge sharing for geothermal experts from all around the world is made possible.



Figure 3: The 2021 group of GTP six-month fellows on a field-trip in the north of Iceland.

The resulting international hub of experts is one of the fundamentals for the success of the training in Iceland. During their time in the training, the fellows get a chance to step out from their own environment and habits and expand their horizon to get a different point of view both professionally and on a personal level. Iceland being one of the leading countries in geothermal research and utilization gives the fellows a chance to experience with their own eyes what geothermal can do and how it matters.

Furthermore, in a world rushing to reach the UN SDGs and in times of conflict, it has rarely been more important to build bridges between countries and continents and to focus on increased cooperation in energy security as well as endorse tolerance towards the fellow man. Examples from the training in Iceland have shown the fellows who share their time and space working towards a common goal generally create understanding of each other across religion, culture, and race leading to less prejudiced individuals who many then advocate for more tolerance in their own country upon their return.

As a UN affiliated graduate, after sharing half a year with people from all around the world, expanding their professional network and making international, intercultural, and interracial friendship bonds, they are expected to have acquired certain leadership capabilities and qualities such as good communication skills, diplomacy, respect for others, and as good leaders, have courage and experience to back up their decisions which is what the GTP aims to instill and achieve with its training in Iceland. Experience through the decades of training has also shown that many fellows have become great leaders of geothermal development in their home countries which further supports how successful the training is really is.

GTP's activities clearly contribute to some of the UN SDG's. In particular, Goal 7: "Ensure access to affordable, reliable, sustainable and modern energy for all" and Goal 13: "Take urgent action to combat climate change and its impacts". Then, its activities contribute indirectly to other goals like Goal 1: "End poverty in all its forms everywhere", Goal 3: "Ensure healthy lives and promote well-being for all at all ages", Goal 8: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" and Goal 11: "Make cities and human settlements inclusive, safe, resilient, and sustainable".

Gender equality and gender issues are a key element in Icelandic foreign policy and gender equality has always been the focus of GTP, and thus it also supports UN Sustainable Development Goal 5: "Achieve gender equality and empower all women and girls". Through the four decades of six-month training at GTP in Iceland, about 25% of the fellows have been women. Yet, the ratio is improving and actually came close to 50% in 2021. Overall, nearly 30% of the MSc- and PhD-students that have graduated are women. Energy related research and development is still quite male-dominated, not least in the developing part of the world, but GTP actively promotes gender equality through a gender balanced candidate selection and by cooperating with our sister programme GEST. GTP will continue to increase the share of women selected for training and MSc/PhD-studies, with the ultimate goal of reaching gender equality in all our activities.

REFERENCES

- Georgsson, L.S., Haraldsson, I.G., and Ómarsdóttir, M. "UNU Geothermal Training Programme in Iceland: Sharing Geothermal Knowledge with Developing Countries for 41 Years." *Proceedings World Geothermal Congress 2020+1*, Reykjavík, Iceland (2021).
- Haraldsson, I.G, Georgsson, L.S., and Ómarsdóttir, M. "United Nations University Geothermal Training Programme in Iceland: Training Activities Abroad." *Proceedings World Geothermal Congress 2020+1*, Reykjavík, Iceland (2021).
- Huttrer, G.W. "Geothermal Power Generation in the World 2015-2020 Update Report." *Proceedings World Geothermal Congress 2020+1*, Reykjavík, Iceland (2021).
- Ómarsdóttir, M., Axelsson, G., Haraldsson, I.G., and Hardardóttir, V. " Successes and challenges of Geothermal Training: Behind the Scenes Insight into the UNU/GRÓ Geothermal Training Programme." Draft paper submitted for the World Geothermal Congress 2023, Beijing, China (2022).