GOPA
WORLDWIDE CONSULTANTS

External Evaluation of GRÓ International Centre for Capacity Development, Sustainability and Societal Change

GTP Case Study Report

September 2024

Authors: Shawn Webb, Johannes Beck, Dr. Matteo Borzoni, Dr. Alfredo Gonzalez Cambero, Franziska Holzaepfel, Julia Schaefer, Tobias Schmolke

ANNEX 12 GRÓ TRAINING PROGRAMME CASE STUDY REPORTS

INTRODUCTION

As noted in the Terms of Reference (ToR) for this evaluation, one of the core evaluation questions is as follows: **What lessons can be drawn from previous interventions by the GRÓ programmes, which can be used as a frame of reference in future endeavours?**

In addition to the overall evaluation of the GRÓ centre, and the evaluation of each of the four Training Programmes (TPs), the evaluators conducted **four evaluative case studies of specific initiatives and approaches** as applied by the individual TP, to generate lessons learned for the future. The ToR defines the specific scope of each case study for this evaluation. For each of the TPs one case study has been prepared. They address specific initiatives and approaches of the Training Programme under review.

The **case study reports provide**:

- An overview of the specific data-collection process and evaluation methodology applied,
- A brief introduction to the initiatives and approaches directly under review,
- Specific evaluation findings linked to the interventions, operational delivery and results achieved,
- Conclusions,
- Lessons learned, and
- Prospects for scaling-up or replication of the intervention in future endeavours of the GRÓ.

A summary of the **specific scope of the individual case studies** is below:

GRÓ FTP	**Regional collaboration in the Caribbean** - Partnership and cooperation of the FTP with regional and country institutions to promote local capacity development of individuals and organizations - The development and delivery of in-country and regional training courses, and the promotion of local capacity to support and maintain the development and delivery of the training offer
GRÓ GEST	**Massive Open Online Courses (MOOCs), innovative online content to promote digital learning** - The potential role of MOOCs as a tool to enhance the range and quality of the overall GEST offer and to achieve outreach in the provision of transnational knowledge transmission and exchange **March 8 Fund (seed fund for GEST Alumni projects)** - The achievements and lessons learned linked to the Fund and the projects of supported alumni - The feasibility to scale-up or replicate a seed money fund across the GRÓ for projects of alumni
GRÓ GTP	**Collaboration efforts in El Salvador** - The development and delivery of in-country and regional training courses, and the promotion of local capacity to support and maintain the development and delivery of the training offer - The potential role of Centres of Excellence in-country for the scaling-up the GTP offer regionally
GRÓ LRT	**Collaboration with universities (with a focus on Makerere University in Uganda)** - Partnership and cooperation of the LRT with universities in-country to promote and support the integration of the LRT offer within the wider context of existing university programmes/offer - The development and delivery of in-country and regional training courses, and the promotion of local capacity to support and maintain the development and delivery of the training offer

ANNEX 12.3: GRÓ GTP CASE STUDY REPORT

CASE STUDY DATA-COLLECTION AND EVALUATION METHODOLOGY

The case study draws on a range of quantitative and qualitative data sources and collection methods, including (1) the review of strategic and operational programme documentation, (2) key informant interviews (KIIs) in El Salvador and remotely, (3) a focus group discussion (FGD) with alumni of the 5-month diploma held in El Salvador, and (4) direct observations of the short course held in February 2024 in El Salvador.

The specific objectives of the case study are:

- Assessing the results of the training efforts in El Salvador
- Assessing feasibility of GRÓ and their programmes to expand the training partnerships with partners in various partner countries to augment development impacts.

Concretely, the case study assesses the following issues on the specific GTP interventions:

- The goals, strategy, and approach of training interventions
- The interventions' coherence with other development efforts
- The interventions' progress towards results
- The programme implementation and adaptive management
- Prospects for the continuation of the programme benefits
- Prospects for long-term development impacts

1. CASE STUDY-SPECIFIC PROGRAMME DESCRIPTION AND CONTEXT

As specified in the ToR, the GTP efforts in El Salvador are the subject of one of the evaluative case studies.

Latin American and Caribbean (LAC) countries have significant geothermal potential along the volcanic range from Mexico to Patagonia. Most of these countries are developing geothermal projects **to reduce dependency on high-cost fossil fuels and contribute to GHG emissions reduction**. The LAC region includes eight of the 32 countries with geothermal installed capacity.[1]

Geothermal training began in El Salvador with date back to 2006 and to 2007. The first workshop for decision makers was held in 2006, which was attended by various experts from Central America and from Iceland. During that workshop it was decided to organize a serious of short training courses. The first of those training courses was held in 2007. Since then, **there have been 13 short courses in El Salvador over the 2006-2023 period, reaching 682 participants[2]**. In addition to short courses, GTP has also organised specialised, longer **geothermal diploma courses** in cooperation with local partners in the country, the first of which was organised in 2010 by the University of El Salvador with support from Italian ODA. The diploma programme was then repeated in 2012 with remaining funds from the first course. The Nordic Development Fund (NDF) and the Inter-American Development Bank (IADB) provided additional funds to support the diploma programme from 2013-2015, with technical assistance from Salvadoran entities like the **Consejo Nacional de Energía (CNE)** and the state-owned geothermal company **LaGeo**. GTP evaluated the programme's effectiveness in its initial two years and continued offering advice by participating in the Academic Committee through 2013-2015. During this time**, each diploma session reserved 10 scholarships for Salvadorans, 10 for Latin American attendees from**

[1] IRENA (2024) Renewable capacity statistics 2024. International Renewable Energy Agency, Abu Dhabi.
[2] Including the mentioned workshop, tailored short courses paid by the Organization of America States and courses paid by GTP

other countries, and up to 10 spots for those without sponsorship. This distribution continued until the diploma's last edition in 2022.

In early 2016, the NDF committed additional funds to continue the diploma course for 2016-2017 with the **Icelandic Ministry for Foreign Affairs (MFA) acting as the implementing agency**. GTP also became a direct implementing partner alongside LaGeo and the University of El Salvador. Due to changes in programme management, including increased responsibilities taken on by LaGeo, the programme was renamed the **Geothermal Diploma Course for Latin America**. Since then, **LaGeo has been the primary local technical partner.**

Following the changes implemented in 2016, **the annual GTP/ LaGeo short course was incorporated into the curriculum of the diploma course**. This allowed both participants specifically invited from the LAC region for the short course and diploma course students to learn about specific topics and opened the opportunity to interact with international lecturers and participants. This integration was maintained in subsequent editions of the diploma. **While the diploma course is primarily conducted in Spanish, short courses are offered in both English and Spanish with simultaneous interpretation.** This bilingual approach caters to a broader audience including the English-speaking nations of the LAC region.

In 2019, the MFA took primary funding responsibility for the diploma course with in-kind contributions coming from LaGeo and the University of El Salvador. A two-year agreement involving MFA, GTP, and LaGeo was established. The diploma course proceeded in 2019 like previous years with plans to repeat it in 2020, but **the COVID-19 pandemic delayed the 2020 session by two years**. The diploma course resumed in 2022 with 27 participants but was not offered in 2023 due to financial constraints. In total, **the diploma trained 230 experts** in geothermal energy since GTP's involvement in 2013 (first with an advisory role until 2015 and then as an implementing partner).

2. FINDINGS

2.1. Programme goals, strategy and approach (Relevance)

The main challenge in the energy sector in LAC is meeting the rising demand for electricity accessing new clean energy sources. Geothermal energy could be a key component in broadening the region's power generation options and addressing growing demand for higher generation capacity. As a reliable and clean energy source, **geothermal energy can supply 24/7 base-load power**, unlike many other intermittent renewable technologies.

There are 25 countries In the LAC region with potential geothermal resources, yet only eight have developed geothermal power facilities. **Less than 15% of LAC countries' estimated geothermal resource potential is utilised for electricity generation.** It is estimated that there is potential of between 11 and 55 gigawatts of geothermal resources in LAC to be used for power generation, but the region's current installed geothermal capacity is only 1.67 gigawatts. [3] If further explored and developed in a sustainable fashion, geothermal resources could provide a significant share of the base-load power needs of the region at a competitive cost, creating direct economic, environmental, and energy security benefits to many LAC countries.

The GRÓ objective is to strengthen individual and institutional capacities in low and middle-income countries (LMICs) to deliver development results in line with the SDGs. The short-training courses and the diploma course conducted in El Salvador contribute to training experts, who are expected to promote geothermal development in LAC. Thus, **the training activities in El Salvador indirectly contribute to SDG 7.**[4] This view assumes that the lack of appropriate skills is a major

[3] WB (2018) Opportunities and Challenges for Scaling Up Geothermal Development in LAC. The World Bank - ESMAP
[4] Ensure access to affordable, reliable, sustainable and modern energy for all.

constraint for geothermal development in the region. In El Salvador and Mexico[5] the exploration of geothermal resources began in the '60s, and the power production started in the 70s.[6] Nicaragua[7] began exploiting geothermal resources in 1983. **But besides these standalone cases, the use of geothermal resources in the rest of the LAC region is much more recent and limited**. Limited skills and knowledge on geothermal development were a recurring topic reported by FGDs and interviews with the diploma alumni and participants of the 2024 short training.

The DAC list of ODA recipients for 2022 and 2023 included El Salvador among lower- and middle-income countries (LMIC), but El Salvador has moved to the Upper- and Middle-Income Countries (UMIC) classification in 2024. As a result, **while training activities conducted until 2023 were in line with the GRÓ objective of strengthening capacities in LMIC, the GRÓ-funded training activities in El Salvador from 2024 onward will no longer be formally aligned with the GRÓ focus on LMIC**. An analysis of the nationalities of participants in the training activities in El Salvador from 2018 to 2023 reveals that the rate of participants from LMICs in the short trainings and diploma course were 60% and 78% respectively (see data included in Appendix I). However, Salvadorian trainees accounted for 39% of the total number of short course participants and 63% of the total number of diploma participants. Therefore, **if this same proportion of Salvadorian participants is retained in the future, the GRÓ focus on LMIC countries could be diminished**.

The training content focus in El Salvador on geothermal resources in volcanic areas is particularly relevant for the region. The training offer of the diploma programme has remained unchanged since GTP assumed the role of primary implementing partner (IP). It consists of eleven modules [8] which cover all relevant topics for the development of geothermal projects. The topics of the short courses are chosen by GTP and LaGeo after consulting relevant institutions **to ensure that the short trainings are relevant to the training needs of targeted institutions.**

The supported training programmes are also relevant to the needs of LaGeo. Specifically, the short courses and diploma offer LaGeo the ability to train its personnel in the latest developments in geothermal energy. The training not only strengthens LaGeo's workforce but also serves as a showcase of its expertise in the region, positioning the company as a highly respected leader in the utilisation of geothermal resources.

2.2. Promotion of synergies between the programme and other local development efforts (Coherence)

No synergies could be identified by this evaluation **with other MFA-funded interventions** because the MFA has no bilateral cooperation in the LAC region.

However**, the supported training activities are complementary to interventions funded by other donors** including a project funded by the German government and implemented by the Federal Institute for Geosciences and Natural Resources (BGR). The project provides technical assistance and capacity building to national partners of the Central America Integration System (SICA) for exploration activities for geothermal resources and assessing their potential to be included in local development planning. **The development of technical knowledge that GTP is promoting through training is particularly**

[5] Quijano-León, J. L. and Gutiérrez-Negrín, L. C.A. (2003). 30 Years of Geothermal-electric Generation in Mexico. Mexican Geothermal Development GRC bulleting

[6] Guidos, J. and Burgos, J. (2012) Geothermal activity and development in El Salvador: producing and developing. Paper presented at the Short Course on Geothermal Development and Geothermal Wells, organised by the UNU GTP and LaGeo in El Salvador on March 11-17, 2012

[7] Porras, E. A, Tanaka, T., Fuji, H and Itoi, R. (2007) Numerical modelling of the Momotombo Geothermal System. Geothermics. Vol 36 (4), pp. 304-329

[8] 1) general concepts, 2) geothermal geology, 3) geothermal geochemistry, 4) geothermal geophysics, 5) integrated conceptual models, 6) drilling, 7) geothermal reservoir engineering, 8) geothermal plants and low and medium enthalpy applications, 9) environmental and social management of geothermal projects, 10) energy policy and management of geothermal projects, and 11) the final project

relevant for the BGR project. In fact, the project has nominated two trainees - one from Honduras and one from Nicaragua - who were accepted for training in the diploma in El Salvador.

Improvements in skills and knowledge are also crucial for the success of grants and loans provided by international organisations for the development of geothermal projects. The Inter-American Development Bank's (IADB) recent analysis on geothermal potential in LAC[9] shows that grants and concessional funding programmes will continue to play a key role in enhancing the viability of geothermal projects. As the IADB explains, one crucial barrier to successful geothermal development in the LAC region is the geological exploration process. This necessary and time-consuming process costs close to US$4 million per megawatt[10] and can last up to three years with only a 60% success rate. Different concessional funding and grant programmes in the region are currently provided by **the World Bank, the IADB, JICA, KfW, and the Caribbean Development Bank (CDB).**

2.3. Progress towards results (Effectiveness)

From 2018 to 2023, GTP organised two one-week courses[11] with a total of 122 participants, 40% of whom were women. In February 2024, GTP organised another two-week short course with 32 participants, 38% of whom were women. During the same period, GTP also organised three editions of the 5-month diploma, one in 2018, one in 2019, and one in 2022.[12] **There were 86 total participants for the diploma of whom 43% are women**. Details on the number of participants by nationality are reported in the appendix.

Through the diploma course, **students attend eleven modules that provide a general coverage of all main aspects of the design and management of geothermal projects**. Unlike the 6-month training in Iceland, where students specialise in a certain area after a 5-week introductory period, all students of the diploma course attend all modules. This approach in El Salvador is more efficient in terms of costs, logistics, and organisational reasons according to LaGeo. Offering students the possibility to choose from different specialisation fields would require more lecturers conducting lessons in different classrooms simultaneously. A FGD with LaGeo employees who attended previous editions of the diploma in El Salvador **revealed that the unified comprehensive approach was largely appreciated**. The approach allowed experts with different backgrounds to gain insights into their colleagues' fields, leading to easier understanding of each other's expectations and needs when working together on the same geothermal development project. Participants of the FGD emphasised that the diploma course helped them understand the entire process of geothermal development, as well as the importance of phases with which they were not familiar before attending the programme.

A LaGeo manager explained that the diploma course should address all relevant topics for geothermal development so that **students become associated with the jargon, methodologies, and tools used in the different aspects of a geothermal development project.** The general curriculum is particularly helpful for people with limited experience in the sector. For example, an interviewed diploma alumnus from Argentina mentioned that when he attended the diploma years ago, he had just started working in the geothermal area for the State Agency of Investment of Neuquén. At that time, he had very limited knowledge of geothermal development and needed a much deeper understanding of general geothermal sector elements to initiate and supervise geothermal exploratory research activities funded by the Investment Agency he works for.

Another interviewee had a different opinion and shared with the evaluation team that such **a general curriculum limits specialisation**. A GTP evaluation conducted for the 2014 edition of the diploma recommended that the diploma organisers[13] consider adding lines of specialisation. Additionally, some

[9] Gischler, G. et al (2020) Harnessing geothermal potential in LAC: A perspective on the road ahead. IADB
[10] Costs are mainly driven by drilling.
[11] A short course was also organised in 2017, but it is not included here since the evaluation period specified in the ToR is 2018-2023.
[12] The diploma was also organised in 2016, but it is not included here since the evaluation period specified in the ToR is 2018-2023.
[13] At that time GTP was not involved as an implementing partner.

students may not be positioned to understand the technical aspects of topics outside of their experiential knowledge causing lecturers to refrain from offering specialised technical lectures. **The main specialisation opportunity offered by the diploma course is the final project,** which is individually conducted by groups or, in a few cases, individually, for one month with the supervision of a seasoned geothermal expert from LaGeo.

While the diploma programme comprehensively addresses all essential aspects of geothermal development, **the one-week short courses are focused on specialised topics.** For example, the 2017 short course taught the feasibility studies of geothermal projects, the 2018 course covered geothermal reservoir characterisation, and the 2022 course explored geothermal energy utilisation in Latin America. The exception to this specialised approach was the two-week training course offered in 2024; it covered different general aspects of geothermal development like the diploma course since the diploma course had not been held since 2022.

Although a short course training does not make students experts, **one unanimously reported advantage of short courses is the opportunity to exchange ideas with lecturers and fellow trainees who have faced similar problems**. For example, an employee of the Federal Commission for Electricity in Mexico attended the short training in 2024 and learned from Costa Rican colleagues how to address scaling deposits problems in geothermal production more cost-effectively than his organisation in Mexico. Additionally, he discovered that similar institutions in Nicaragua and Costa Rica use a different business model for managing drilling costs, which he plans to propose to his superiors in Mexico. A trainee from Colombia reported that, after attending a lecture on drilling risks, she immediately contacted her colleagues back home to incorporate the new, proper drilling risks into their procedures. Her team has limited experience in geothermal drilling since they primarily drill for oil in different types of rock, which involves different risks.

In both the diploma and short courses, former students from the diploma programme or training in Iceland (including the 6-month supported MSc training) give lectures to present their work. This approach fosters networking opportunities for alumni.

2.4. Programme implementation and adaptive management (efficiency)

GRÓ GTP is responsible for the overall oversight of both the diploma programme and the short courses. LaGeo is in charge of local management for both training activities. The University of El Salvador (UES) contributes to the diploma to ensure that it meets certain academic quality standards.

An academic committee of representatives from GTP, LaGeo, and UES was established to steer the diploma programme. Its main role is to make decisions on the diploma programme, the recruitment of lecturers, and the selection of students. Balancing students' backgrounds, gender, and country of origin is a main criterion in the selection process. Until 2014, there was a technical committee in addition to the academic committee. The technical committee made decisions on the duration of the different lectures and modules. Since 2016, these aspects have not been changed, and consequently, the technical committee is no longer needed for the diploma. Short courses are managed jointly by LaGeo and GTP, similar to the diploma. The main difference is that **UES is not involved in short courses**.

Regular surveys collect students' feedback about many different aspects of both the short courses and the diploma. These cover topics such as general satisfaction, relevance of the trainings to the students' interests and work, quality of lectures, quality of the field trips, the final project work for the diploma, general organisation of the trainings, quality of facilities, food provided, interpretation services, and accommodation. Provisions are made so that trainees can also provide detailed and qualitative comments.

The diploma also includes a student assessment system managed by UES. Students' performance is assessed for each of the eleven modules, and the final grade is determined through a weighted score with different values assigned to the modules and the final project. LaGeo and GTP provide a final report that includes students' scores, the results of the surveys, and a description of all activities conducted. The final report also contains a logical framework of the diploma programme **and relevant and measurable monitored indicators**.

GTP strongly relies on LaGeo for the organisation of both the short courses and the diploma course. **Training and laboratory facilities are provided by LaGeo**. Previous editions of the diploma included some lectures and activities at UES facilities, but diploma programme organisers decided to use only the training and laboratory facilities provided by LaGeo to avoid wasting time in transport and because the UES labs lacked the necessary reagents and staff to manage the laboratory.

The 2022 diploma report shows that **37 of the 41 lecturers were employees from LaGeo**. LaGeo has the required technical expertise to lecture on geothermal energy being a leading expert in the sector. During the last four editions of the diploma, UES has provided only three to four lecturers. A key informant from UES in El Salvador explains **that earth sciences are not prioritised at the university explaining the limited expertise UES can provide**. This fact was widely confirmed by informants. Short courses have a much higher variety of lecturers coming from regional and Icelandic geothermal development institutions such as ÍSOR and GTP in addition to LaGeo.

Direct costs for trainings have been largely funded by GTP. In addition, GTP has paid for the costs of one or two Icelandic lecturers, who contribute to all editions of trainings. **LaGeo's contribution was mainly in-kind**, as it provided facilities for the training and most of the lecturers. An analysis of the annual reports provided by LaGeo shows that **in 2018 LaGeo substantially contributed to the cost of the diploma course** when its contribution amounted to 45% of the total budgeted costs of the diploma and the short course.

Table 60 includes cost information for the 2022 short course and the diploma in El Salvador.

Table 1: Cost data per training activities in El Salvador in 2022

	DIPLOMA	SHORT COURSE
Total expenditures (USD)	209,763	66,632
Number of students	27	46 φ
Cost per student (USD)	7,769	1,453
Cost per student per day (USD)†	51	264

* WB average exchange rate in 2022: 135.3 ISK/USD
φ: It also includes the 27 students who attended the diploma
† The diploma lasted 151 days and the short course lasted 5.5 days

The table shows that **the daily cost per student per day of the diploma programme is extremely low when compared to the short course** due to several reasons: only ten scholarships for non-Salvadoran students were provided, travel costs are the same but spread over many days for the diploma programme, and the long-term housing accommodations for the diploma programme cost less per day than the hotels used for the short courses. The cost of the diploma per student (7,769 USD) is also much lower than the cost of the 6-month training in Iceland – which, as reported in the notes shared by GRÓ for the 2024 budget proposal, cost 4,280,000 ISK (31,000 USD) per 6-month training fellow. Overall, this suggests **a very high value for money of the diploma**.

In addition, both training activities are used by GTP to properly observe (and interview) students who are applying for the 6-month training in Iceland. This way, GTP ensures that nominated candidates[14] who can make the most of a more expensive training in Iceland are selected for.

Only public institutions are eligible to nominate candidates for the scholarships. While private institutions may nominate experts for the short courses, they must bear all associated costs. However, no additional fees are charged in such cases. The diploma programme does not accommodate international students whose expenses are covered by their employers. This possibility was discussed

[14] As explained in the GTP evaluation report, candidates for the 6-month training in Iceland are nominated by companies and institutions.

when the first editions of the diploma, but it was concluded that willingness to companies to cover relevant costs was very low.

2.5. Prospects for the maintenance/ continuation of the programme benefits (Sustainability)

The sustainability of the training programmes in El Salvador depends on a continued partnership with LaGeo. LaGeo has demonstrated ownership and commitment to the programme by providing its facilities and staff for the implementation of the GTP-funded training programmes. Overall, **LaGeo has proven to have the necessary human and technical capacity for a continued provision of geothermal trainings.**

While up to this point GTP has paid the majority of costs to cover training activities in El Salvador, **LaGeo will fund the diploma through its own resources in 2024**. More precisely, at the time of writing, a new diploma has been planned to be held in August 2004. This edition will have a shorter duration (three months), but it will almost entirely be funded by LaGeo, while GTP will provide minor funds and will contribute with contribute by covering the costs of two Icelandic experts lecturing for one week. This would mean that LaGeo it would fund scholarships, accommodations, and international travel for students in addition to its duties providing staff time, training, and laboratory facilities. **No major responsibility changes are expected for short courses**. The greatest burden of financial costs of short courses will continue to be paid by GTP.

The diploma programme has gained considerable recognition in the region making LaGeo a reference institution for geothermal energy. Increasingly, more countries are proposing candidates for both the short training courses and the diploma programme. This trend indicates a sustained demand for geothermal training.

2.6. Prospects for longer-term development effects (Impact)

While impacts at the macro level are more difficult to assess, various results at the individual and organisational level were reported in interviews with alumni of the diploma. These benefits include one alumnus reporting having changed the self-protection equipment used for certain operations within the company he was working for. Another convinced the Instituto de Electricidad de Guatemala (INDE) to buy new equipment for its lab to measure fluid inclusion. Another civil servant from Argentina was granted additional responsibilities and became the chief of the geothermal area in the institutions he works for.

Also, one main reported advantage of the training programmes in El Salvador is that they are held in Spanish, key to reaching trainees in the region that do not speak English.

The training activities funded by GTP in El Salvador drive the development of geothermal energy in LAC. Training activities raise interest among relevant actors on the potential of geothermal energy in the home countries of programme alumni. This becomes the main impact of GTP-funded training activities in El Salvador.

2.7. Horizontal themes/ cross-cutting issues

The training organisers aim to achieve gender balance in both the diploma and short courses. The gender ratio calculated across all training participants in El Salvador from 2018 to 2023 is 41%. **An analysis of the participants by training type reveals steady improvement of the gender ratio in the diploma programme**. In 2018, the gender ratio was 33%, and in the last two editions, it was 52% (in 2019) and 44% (in 2022). **However, while there has been quite a high variability in the number of women attending training in El Salvador[15], the gender ratio of short training participants showed a declining trend in most recent years.** The gender ratio 48% in 2017, then decreased to 41%

[15] Haraldsson, G.I, Georgsson, L. S. and Ómarsdóttir, M. (2021), United Nations University Geothermal Training Programme in Iceland:
Training Activities Abroad. *Proceedings World Geothermal Congress 2020+1*. Reykjavik, Iceland, April - October 2021

in 2018 and 42% in 2022[16]. By 2024, the percentage of female participants in the short course fell to 38%. Despite this decline, **the gender ratios achieved by the training programme in El Salvador are relatively good considering that men are generally vastly overrepresented as geothermal experts.**

One advantage of **the diploma course** is that it **is very accessible for Salvadoran women**. One female alumnus stated how going to Iceland for the 6-month training was impossible due to family obligations largely assigned to women, such as childcare. Gender balance is far from being achieved when calculated among lecturers, again due to the historical overrepresentation of men in the wider geothermal field.

It is worth mentioning that the participation of trainees in Women in Geothermal (WING) is actively encouraged among trainees in El Salvador. WING is an organisation dedicated to promoting the education, professional development, and advancement of women in the geothermal community.

Environmental aspects are adequately covered in the training offerings in El Salvador. Environmental and social management of geothermal projects is one of the eleven modules of the diploma. Environmental aspects and risks of geothermal development were also included in the 2017, 2022, and 2024 editions of the short courses.

3. CONCLUSIONS

Despite the substantial geothermal potential in LAC, only a small fraction has been harnessed for power generation. **The short courses and diploma courses in El Salvador have played a crucial role in filling the skills gap, which is needed to access geothermal resources**. The training activities in El Salvador have strongly contributed to creating a relatively large mass of experts in LAC.

The GRÓ objective of strengthening capacities in LMICs is fulfilled through the high participation rates of individuals from these countries in the training programmes. However, the reclassification of El Salvador to an UMIC poses a challenge to aligning future GRÓ-funded activities with the objective of focusing on LMICs. Given that a significant proportion of participants have been Salvadoran, the ongoing alignment of these programmes with GRÓ objectives will require careful consideration and potential adjustments in participant selection.

Since 2018, GTP has organised multiple short courses and diploma programmes reaching a total of 122 participants in short courses and 86 participants in diploma courses. **The geothermal training in El Salvador to which GTP has contributed has thus addressed a critical need for skilled professionals in geothermal energy**. Geothermal energy is a resource with substantial untapped potential in the region. The comprehensive diploma curriculum consists of eleven modules detailing all main aspects of geothermal project design and management. This curriculum has been particularly well-received by participants as their feedback indicates that the programme's broad approach has facilitated a deeper understanding of the scope of the geothermal development process. **While this comprehensive combination of topics in the diploma curriculum has proven beneficial for those with limited experience in the sector, such general coverage approach does not allow for the specialisation needed to drive sector development**. If offering many different specialisation fields (as done for the 6-month training in Iceland) is not an option due to cost and logistical considerations, a possible alternative could be to offer **two broad specialisation areas**: one for the earth sciences (including geothermal geology, geochemistry, and geophysics) and another for plant development and drilling.

Efficiency in programme implementation has been ensured through strong partnerships with local institutions like LaGeo and the UES. **The cost-effectiveness of the diploma programme, especially when compared to similar programmes offered in Iceland, highlights the value for money achieved through these local partnerships.**

Sustainability of the training programmes appears promising, particularly with LaGeo's increased sense of ownership and potential to fund future editions of the diploma course independently. The

[16] For these calculations short training participants who also attended the diploma were included in the short training only.

programmes have also gained regional recognition causing more countries to nominate candidates to both training lines and signalling a continued demand for geothermal training.

Interviews and FGDs revealed that the training programmes have had a positive impact on both individual and organisational levels. Alumni have reported career advancements and improvements in operational practices within their respective organisations.

Finally, the training programmes have made notable efforts to address gender balance and cross-cutting issues. **While achieving gender parity among participants has had mixed results, the overall progress is commendable given the traditionally male-dominated nature of the geothermal sector**. The emphasis on environmental and social management within the curriculum further strengthens the relevance and comprehensiveness of the training offered to cross-cutting issues.

4. Lessons learned and prospects for the expansion or replication of the intervention in future endeavours of the GRÓ

The approach used by GTP in El Salvador, which involves repeated sequences of training with the same partner organisation in the same country, has been effective in building a skilled workforce capable of advancing geothermal energy development in the LAC region. This method has proven to be a feasible option if GRÓ intends to expand the training programmes with other partners to enhance their impact**. Continued support and adaptation to changing circumstances will be crucial for maintaining and enhancing the impact of these valuable programmes.**

The GTP's experience in El Salvador suggests that extended collaboration with partner organisations to deliver repeated trainings are a feasible modality to expand trainings in partner countries. The success of the GRÓ GTP (previously UNU GTP) in El Salvador requires the active engagement of a well-established state-owned geothermal company. This company has a long history of geothermal development and a strategic vision and incentive to contribute to the growth of the geothermal sector in the region. Companies like LaGeo are well-equipped to provide specialised professional expertise with the necessary skills for acquiring geothermal development. **To replicate the training in other countries, it will be crucial to identify partner organisations that have strong expertise in geothermal development, a strong commitment to the advancement of the geothermal community, and a long-term vision to promote the utilisation of geothermal resources.**

APPENDIX I

Table 2: Total number of participants by nationality for short training and the diploma in El Salvador

	Short courses			Diploma			
	2018	2022	Total	2018	2019	2022	Total
High income							
Chile	1		1		1		1
St Kitts & Navis	1	1	2				0
Total	2	1	3	0	1	0	1
UMI							
Argentina	2	2	4	1	1	1	3
Colombia	6	5	11	1	2	2	5
Costa Rica	3	1	4				0
Dominica	1	1	2				0
Dominican Rep.		1	1			1	1
Ecuador	1	2	3		2		2
Guatemala	1	1	2				0
Jamaica	1		1				0
Mexico	6	3	9	3	1	2	6
Montserrat	1	1	2				0
Peru	1	1	2		1		1
St Lucia	1	1	2				0
St Vincent & the Grenadine	1	1	2				0
Total	25	20	45	5	7	6	18
LMI							
Bolivia	3	2	5	1		1	2
EL Salvador	33	14	47	18	19	17	54
Honduras	2	3	5	1		1	2
Nicaragua	11	5	16	5	2	2	9
Total	49	24	73	25	21	21	67
International organisations)		1	1				0
Total	76	46	122	30	29	27	86