



UNITED NATIONS  
UNIVERSITY

GEOTHERMAL TRAINING PROGRAMME



LaGeo S.A. de C.V.

## ENVIRONMENTAL ASPECTS OF GEOTHERMAL UTILIZATION: A CENTRAL AMERICAN PERSPECTIVE

José Antonio Rodríguez<sup>1</sup> and Ana Silvia Arévalo<sup>2</sup>

LaGeo S.A. de C.V.

15 Av. Sur, La Libertad,

EL SALVADOR

<sup>1</sup>*jarodriguez@lageo.com.sv*

<sup>2</sup>*sarevalo@lageo.com.sv*

### ABSTRACT

Large renewable energy projects should be carried out in order to meet the energy demand of the Central American region. Among these projects is the geothermal resources development, which is considered to be more stable and with great potential for electrical power generation.

As any large energy project, the geothermal utilization for electrical power generation can cause some adversities during the construction and/or operation stages. This could occur when prevention or mitigation measures are not taken into account, and when the company's environmental policies and procedures are not applied. For this reason, respect for the environment and social concern must be considered in the early stage of the project to guarantee its sustainability.

The main objective of this paper is to know the current state of the geothermal companies' environmental performance in the region, and their perspective to short, medium and long term to achieve a real sustainable development according to the protocols, agreement, understanding, etc, signed among the Central American countries.

The methodology applied in obtaining data from the different geothermal companies in the region was carried out through a series of questionnaires filled by the management in charge of the company's environmental section. Some recommendations from the author of this paper have been based on the sustainable projects with modern concepts of social responsibility.

### 1. INTRODUCTION

Central America continues to be a strategic link for industrial, commercial and financial activities between North and South America and other important countries in the world. This means that consumption of energy will grow rapidly in the coming decades, which will allow countries to make changes in their energy policies to reduce the fossil fuel dependence. They must look for a diverse energy supply based on renewable resources in order to decrease the global and local environmental and economical impacts.

The Central American renewable energy development tends to grow fast. For example, Costa Rica produces almost 98% of renewable energy, El Salvador relies on hydro and geothermal resources up to 50%, Panama on hydro, also up to 50% however, Guatemala, Honduras y Nicaragua rely more than 50% on thermal sources for its electrical energy generation (Cuevas, F., February 2006). These last three countries are willing to develop some geothermal projects with the possibility of increasing the renewable energy generation.

The legal instrument for the impacts on planning and prediction for geothermal development projects is known as the Environmental Impact Assessment (EIA), which allows the selection of alternatives that best guarantee the protection of the environment during the design and the execution of the project.

In Central America, EIA process differs from each country; however, in some countries, it has become an overload for the projects, a slow process and a source of complaint from the users.

The main focus of this paper is to know the present environmental condition of the geothermal developers in the region and their perspectives to improve the environmental performance, in order to guarantee the Central American sustainable development by taking advantage of its own natural renewable resources.

## **2. GENERAL ASPECTS OF THE REGION**

### **2.1 Location**

Central America is bounded to the North by the Atlantic Ocean, to the West by Mexico and the Pacific Ocean and to the Southeast by Colombia.

Geothermal resources for electrical power uses arise mainly in those countries situated along the volcanic chain in the Pacific Rim such as Guatemala, El Salvador, Nicaragua and Costa Rica, where the geothermal potential is concentrated. Honduras and Panama are generally considered as having lesser geothermal potential than their other four neighbours, most of which are low-temperature resources (J.A, Rodriguez and Ada Herrera, August, 2007).

### **2.2 Key figures**

Some Central American statistics are given in the following:

- 35 million inhabitants.
- Over an area of 501,000 Km<sup>2</sup>.
- 50 % under the poverty line
- In 2025, about 70 million inhabitants are expected
- 30 aboriginal groups
- 17 % of terrestrial species
- 50 % remaining of the original forests
- Natural disasters losses surpass the GDP

### **2.3 Power data**

The total installed electricity generation capacity of Central America is 9,270 MW, with a maximum available capacity of 7,500 (variable). The peak load is 6,225 MW, with an average growth rate of 5 %/year. Annual (2005) generation is 35,758 GWh, with 2,697 GWh (7.5%) coming from geothermal power plants, compared to 12,970 GWh (36.3%) produced from thermal plants, and the remainder from hydro and cogeneration. (Rodríguez, J.A, and Herrera Ada, August, 2007).

## 2.4 Main geothermal power generators in the region

Table 1 presents the Central American geothermal power companies' current generation and some future projects. Of all the seven companies, the Miravalles geothermal field is run by the state-owned company (ICE), while the rest are multinational or private companies with partners such as ENEL, Ormat and Polaris.

TABLE 1: Central American geothermal power companies.

COUNTRY	POWER COMPANY	CURRENT GENERATION (MWh)	PROJECTS (MW)	PROJECTS COMMENTS
<b>GUATEMALA</b>	Ortitlan (Calderas) Zunil Power	20.0 27.8	30	Exploration Stage by INDE
<b>HONDURAS</b>	Geo Platanares (ETELSA)	-	35	Exploration stage suitable for a low-temperature binary cycle development
<b>EL SALVADOR</b>	Ahuachapán Berlín (LaGeo, S.A de C.V)	95 109	9.5 25	Binary cycle, Chinameca field exploration stage
<b>NICARAGUA</b>	Ormat Momotombo Power Polaris Geothermal GeoNica (ENEL Italia – LaGeo)	77.5 10 -	35 50	Feasibility study exploration stage
<b>COSTA RICA</b>	Miravalles (ICE)	160.5	35	Mesoamerica Group Exploration stage
<b>PANAMA</b>	ETESA	-	-	Private initiative for tourist proposal

From Table 1, almost 200 MWh of clean energy would be available at medium term where more than 1 million ton CO<sub>2</sub> will be withheld in the region and a possible CDM participation.

If exploration projects in the future will be successful, then the geothermal companies should design a social benefit strategy for local communities, as a challenge to achieve harmony with their stakeholders.

## 2.5 Environmental legal and institutional framework

The most common legal instruments for environmental management in the region are:

- Environmental Impact Assessment process
- Public Consulting
- Permits
- Environmental Information System
- Law for Protected Areas
- National Investment Fund
- Audits

The instruments mentioned above are part of the countries' environmental laws and national authorities are in charge for their application.

The legal and institutional environmental framework of the region is shown in Table 2.

TABLE 2: Legal and institutional environmental framework.

COUNTRY	REGULATORY FRAMEWORK	YEAR OF APPROVAL	ENTITY NAME	COMMENTS
Guatemala	Environment and Improvement Protection Law	1986 (2000)	Natural Resources and Environment Ministry (MARN)	EIA process
Honduras	Environment General Law	1993	Natural Resources and Environment Secretary (SERNA)	EIA process
El Salvador	Environment General Law and its Regulation	1998	Natural Resources and Environment Ministry (MARN)	Project Categorization in processing
Nicaragua	Environment General Law and its Regulation	1996	Natural Resources and Environment (MARENA)	EIA process
Costa Rica	Environment Organic Law	1995	Environmental National Technical Secretary (SETENA)	Project categorization and EMP for public sector in processing
Panamá	Environment General Law	1998	Environment National Authority (ANAM)	Manual and Guide for EIA

As for the legal permits for concession of geothermal areas, construction, operation or expansion of the power plant, the Environment Ministries of the region spend a lot of time in processing, in most cases, delaying the development plans and economical impacts for the developer. However, great efforts have been made in order to reduce the processing time. For example, in September 2006, a "New model of EIA administration in Central America Project" was presented, which was supported by CCAD-UICN. Among its objectives was the participation of the local government, private sectors and society within the environmental authorization process. Costa Rica applies project categorization as preliminary EIA, where the developers define the next steps for their projects. In Panama, the ANAM users have EIA Manual Guide to obtain permit.

### 3. ENVIRONMENTAL ASPECTS - RESPONSE FROM CENTRAL AMERICAN GEOTHERMAL POWER COMPANIES

#### 3.1 Environmental aspects diagnosis

Table 3 presents a summary on the outstanding environmental aspects carried out by the geothermal energy companies in the region.

TABLE 3: Environmental aspects summary from region countries.

ENVIRONMENTAL ASPECTS	GUATEMALA	HONDURAS	EL SALVADOR	NICARAGUA	COSTA RICA
Environmental Management System	Under governmental guidelines	Under governmental guidelines	Under SRE guidelines	Under governmental guidelines	ISO 14001 (Non Certified)
Enterprise Environmental Policy coherent with Sustainable Development	NO	In process	YES	YES Polaris Energy	YES
Monitoring Programme: Air, Water and Soil Quality.	N/A	air, water and soil quality	Air, water and soil quality. Climate parameters	Air, water and soil quality	YES add microseismic and subsidence
Measurement equipments calibrated and certified	N/A	NO	YES	YES under LaGeo contract	YES
Annual Environmental Goals	NO	NO	Activities listed according the project		YES
Environmental Unit (formal structure )	NO	Environmental Engineer Department	Environmental Unit	Environmental Management	YES
Significant Environmental Impacts (negatives)		Soil modification borehole test	Soil modification and noise	Construction stage	Noise
Annual Environmental awareness Programme (internal and external)	NO	NO	According values programme	In processing	YES
Risk Analysis on critical activities	NO	YES	YES	NO	NO
Annual Environmental Audits or Inspections (internal or external)	NO	DECA (SERNA) and internal review	MARN and weekly internal inspections	In processing	Annual internal report
Community attention programme	NO	YES minor scale non public opposition	YES FundaGeo NGO's opposition	YES minor scale non public opposition	YES minor scale NGO's opposition
Environmental Management Perspective (5 years)	Unknwon	Social Responsibility Geothermal developing	Sustainable development indicators application	Social Responsibility Geothermal developing	ISO certification

The information was provided by the person in charge of the environmental management through a series of questionnaire, which was structured under five aspects: company general data, legal framework accomplished, company environmental management plan, community attention and their perspectives to short, medium or long term.

### **3.2 Results**

According to the data from Table 3, most on the countries with geothermal company are building their own environmental management on a systematic way, even in the early stages of the project (like the Polaris Energy case, which began its back pressure power plant in operation two years ago). GeoNica has also had very good institutional relationship as well as communication plan on the Hoyo Monte Galan and Managua Chiltepe exploration projects. Costa Rica, through ICE, uses the ISO 14000 guidelines as EMP.

Air, water and soil monitoring programme is taken in account by all the companies as well as its significant impacts. Risk analysis on geothermal projects has not been implemented by most of the geothermal companies, with the exception of LaGeo and GeoPlanares.

Most geothermal companies have created a formal organizational structure, which demonstrates the importance of the environmental management in agreement with their internal policies.

LaGeo has gone beyond the law as its modern management vision has put synergy to all the employees, shareholders, suppliers, etc., where social responsibility philosophy is taken into account in its activities.

With the exception of LaGeo, which has a Foundation to help the communities around the projects in execution, the rest of the geothermal power companies have made less effort in working with the community. However, they still have a chance to design a programme for the success of the project.

Frequent internal audits as well as environmental education programmes should be a priority for all geothermal companies in order to improve their environmental performance.

## **4. CENTRAL AMERICAN GEOTHERMAL COMPANIES' PERSPECTIVE**

### **4.1 Recommendations**

- Central American energy sector today is widely covered by an environmental legal framework and many environmental programmes from developing countries are available. Breeding of cods, good safety and environmental practice, eco-efficiency, cleaner production or environmental management system (ISO 14000) should be some excellent forms of improving the economic, environmental and social performance of the region.
- There are 490.5 MW of geothermal installed capacity in Central America, of which approximately 405.0 MW are available with possible CDM participation and some good experience for geothermal projects could be shared through a workshop or direct training by specialists in the matter.
- The Central American countries should establish a permanent social network among geothermal project developers at a regional level in order to look for environmental and social common interest, as well as the political and normative government proposals with geothermal development benefits of the region.

- A new model of EIA application for geothermal projects as regional level proposal should be presented at the Central American Environmental Commission and Development (CCAD), which has a direct contact with the Environmental Ministries, in order to standardize the EIA process for geothermal projects.
- Central American auditing programme for geothermal project execution would be a tool to improve the environmental performance among the companies. This has become an important objective as auditors have more geothermal environmental knowledge than other sectors.

## 4.2 Perspectives

### Short term:

- Make new model of EIA application for geothermal projects at regional level to the CCAD through the environmental network of geothermal companies.
- Include the Central American geothermal training programme in Iceland, concerning the Clean Development Mechanism (CDM) on new geothermal projects to assure the viability of the geothermal development projects.

### Medium term:

- An environmental management technical committee at Central American level with joint venture among the geothermal companies, promoting the environmental awareness and inter-company external auditing plan, which would help in the company's continuous improvement in an objective manner.

### Long term:

- Creation of sustainable development indicators for geothermal projects of the region as a means of control to improve its social and environmental performance. These indicators could be presented on annual reports and could be sent to the Environmental Ministries of each country.

## 5. ACKNOWLEDGEMENT

The authors would like to express their gratitude to all of the Central American colleagues for sending the information on time. It is expected that this information would help the geothermal companies' environmental growth and development of its personnel.

## 6. REFERENCES

Rodríguez, J.A., and Herrera, A., 2006: *Geothermal Resources Development in Central America, Workshop for Decision Makers on Geothermal Projects in Central America*, UNU-GTP, 2006.

Arevalo, A.S., 2006: *Environmental and Social Issues in Geothermal in El Salvador, Workshop for Decision Makers on Geothermal Projects in Central America*, UNU-GTP, 2006.

Personal communication with those Central American geothermal company Environmental Units in charge.

[www.eia-centroamerica.org](http://www.eia-centroamerica.org)

[http://www1.eere.energy.gov/geothermal/enviro\\_impacts.html](http://www1.eere.energy.gov/geothermal/enviro_impacts.html)