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Rural Uses of the Geothermal Resources in Guatemala since Old Times and Present Law of Incentives to Promote the Geothermal Energy as a Renewable Resource

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ABSTRACT

The country posseses low enthalpy geothermal resources that have been used since ancient time by the maya civilization that actually represents the rural Guatemalan population. They are still using the geothermal resources as the pioneers did, for bathing, dying, cooking and some as religious ritual, according to their culture.

The geothermal rural use is located in the western part of the country (Totonicapán, Quetzaltenango) which is an area identified with geothermal springs and with maya heritage (Quiches) and in the central and eastern part of the country. The western have also developed the high enthalpy geothermal resource constructing a geothermal power plant, actually in operation (ORZUNIL GEOTHERMAL POWER PLANT) by Ormat Limited.

Due to the existence of the geothermal resources in the country estimated in 1000 MW, and in order to promote the exploitation of it, an incentive law has been promulgated to improve the foreign investment. This law takes into account exemptions to the investors consisting in tax exemptions related to the project under construction.

1. INTRODUCTION

The maya civilization occupied an extensive territory formed by the actual state of Chiapas and Yucatan (Mexico) Guatemala, Belize, north of Honduras and some part of El Salvador. Actually the Guatemalan population is maya descendent and in most of the rural areas the maya heritage is located as: Quiches, Kekchies, Mames, Cackchiqueles and Tzuthuiles, whom in many ways conserve traditions, ritual and costumes from their ancestors.

Central America is a land of very intense tectonic activity. The Mayas located in the northern part of Guatemala (today Peten) probably received migration from others located at volcanic sites but they were not exposed to the volcanic activity due that land is a plateau, where there is not a volcanic chain. History tell us, that due to plagues, hurricanes and floods they started to emigrate to the south in where the volcanic manifestations are located and the population found the sites attractive to change from nomadic hunter to agriculture. The maya religion had two defined lines: premaya and maya. The premaya divided in successive stages: in the first stage they adored and fear to the nature forces, and the head of the family was also the religious head. There were not temples, the agriculture and the conversion from nomadic to sedentaries, -second stage- made them to construct temples, gods and priests. In the third stage the priests created the writing, calendar and the chronology. This was the heritage received from the primitive maya culture that was followed by to classic stages Old and New Empire Maya.

Then the religion became complex and passed to one to other empire with transformations but on the old modules and the introduction of human sacrifice by Mexican influence. The mayas had a Creator God, Hunab-ku maker of the world, the humanity and the world. The Creator son was Itzamná or Itzaná. They also believed in the Deluge and the world destruction. In the Dresden Code there is a light blue snake and the constellation symbols and two solar and moon eclipses with water flood all over. They also believed in good and evil, and associated thunder, storms and rain with the good, because they were the ones that provide the growing. The wars, droughts, and drunkenness were associated to the evil.

When the Spaniards in 1542 came to Central America and conquered, they made all the population catholic but all the traditions and customs of the mayas, have been made a mixture of costumes in the population that still conserve rituals dedicated to God and concepts between good and evil.

2. GEOTHERMAL RURAL USES

In the western part of the country among the volcanic chain the geothermal manifestations are located and the rural uses are devoted to domestic uses.

2.1 Thermal Bathing

Quetzaltenango has multiple geothermal manifestations due to the volcanoes; some of these manifestations are fumaroles and hot springs. Zunil has been known by the geothermal potential and actually on this site the geothermal power plant ORZUNIL LIMITED is in operation.

The population of the zone has been dedicated through years to agriculture and uses the geothermal springs as irrigation and bathing.

Cerro Quemado comes from the Quiche word Catinocjuyup, it has a fumarolic activity along the skirts and 3,197 height. The thermal baths are located at Los Vahos and Almolonga. Los Vahos is a place where the sulphur gas is characteristic and it is 3 km from Quetzaltengo city, it has been used by generations as a curative bath. The other baths are at Almolonga located northeast of Los Vahos, they are from the same Cerro Quemado activity, they do not have a public pool, they are artesian type. **Figure 1**

On the road to Cantel there are the baths named “Aguas Georginas”, that are visited by tourist and it’s the most tourist-exploited bath of the region.

The believe and traditions are part of the maya culture and all together still exist in this part of the country and has made of Cerro Quemado a place of religion. Today Catholics and Protestants climb the volcano trying to be near the heaven, and they usually said: "That to climb is a sacrifice to God." **Figure 2**

At the same time the belief between evil and good is also represented because there are caves in front of Cerro Quemado known as Juan Noj caves in where the witch takes care of the requests and make the work for some amount of money or gives protection for the harvest or do some curative help to the people.

The area of Totonicapán also is well known for their thermal manifestations use the baths with curative characteristics due to the sulphur content. Peña de Leon Rina Guisela, (1991) The population is maya-quiché and there are maya ceremonial sites in where they celebrate the Wakxakib Batz or the maya new year, some of them related to thermal manifestations. The baths are known as "aguas calientes" hot water located at San Bartolo Aguas Calientes, Termas la Guaca, Termas de Momostenango, in which the dying of the wool also has been used for years, and their ponchos are well known for their quality. Other sulphur manifestations are: Palá, Palá Chiquito, Pala Grande, El Barranco, Salitre, Paxeyú and El Purgatorio The geothermal sites in Totonicapan area that are of greatest interest due to the indications of high sub-surface temperatures, Xejuluytu and El Salitre (210-230 ºC), Pala Chiquito and Patzam form approximately an equilateral triangle with an area of just over 20 km².It is considered to be a major importance to reveal by resistivity surveying, there a sufficiently hot, continuous geothermal reservoir under this whole area, In many exploited geothermal fields of the world it is common to produce steam from each km² of well field to generate some 15 MW electric over a period of several decades. Arnorsson (1997)

In the central part of the country Amatitlan geothermal field also posses in the surroundings multiple geothermal manifestations that have been used as thermal bathing, located around the Amatitlan Lake and in some geothermal springs they use for cooking (boiling eggs). These manifestations are associated to the Pacaya volcano.

The rural use of the geothermal springs has been devoted in most of the manifestations to bathing, but it is not a developed industry, it remains ancestral and rudimentary according to the area with their culture. The most developed is the Amatitlan geothermal area.

3. INCENTIVES TO PROMOTE THE GEO-THERMAL ENERGY

To promote the use of renewable resources in Guatemala a law of incentives has been promoted to encourage private investors to develop the resources including the geothermal. Guatemala has renewable resources that could be useful to the country and their use will give the country independence from buying the fossil fuels, providing at the same time economic energy supply that favors the final consumers and the Guatemalan and the Central American population. At the same time this law encourages the environmental quality and the participation of renewable energy investors. The law was promulgated on November 2003 as "Law of incentives to develop renewable energy projects".

The law objective is to promote and develop the renewable energy projects and establish the fiscal, economical and administrative incentives for that reason.

In order to fulfill the objective the Ministry of Energy and Mines should be:

a) Promote an inventory and localization of the renewable resources that could be use for electric production.

b) Stimulate the studies to use the technical potential

c) Facilitate the investments for the electric generation development through the rational use of the renewable resources.

d) Favor the energetic offer through the renewable resources, given more national independence in relation to the imported fossil fuels.

e) Facilitate the energy certification processes in the country through the use of the renewable resources.

3.1 Definitions:

-FIE-: Project commercial operation date

-Competitive part-: The Ministry of Energy and Mines through its dependences will be the only competitive part to know and solve all the technical aspects related to the application of this law.

-Pre investment period-: It's the period in where all the feasibility studies and design are realized. (It does not include the idea phases and pre feasibility studies).

-Execution Period-: It's the period in which the construction activities are realized. It starts after the end of the pre investment period and ends at the start operation period.

-Operation Period-: It's the period in which the commercial operation activities are realized. This period starts since the project commercial operation date (FIE) until the useful life of the project

-Renewable energy resources-: the resources that have a common characteristic, that never end and they are natural renewable, include the solar energy, the wind energy, hydro energy, geothermal energy, biomass, tide energy and other that in the future may classified the Ministry of Energy and Mines.

3.2 Incentives

The Municipalities, Instituto Nacional de Electrificación – INDE-, mixed entities and the individual and legal persons that execute energy projects with renewable resources will enjoy:

a) Tax exemption for the imported machinery and equipment that will be use for the project during 10 years.

b) Internal revenue tax exemption for 10 years starting since the project commercial operation date.

c) Other minor tax exemptions related to the project under construction.

3.3 Reduction Emission Certificate:

The reduction emission certificate will belong to the project owners, who will benefit from them. These certificates will be emitted by the part competent, according to the project reduced emissions quantity.

The emissions trading establish a tradable unit which is metric ton units of CO_2 emission reductions or CO_2 equivalent emission reductions, Carbon dioxide equivalents (CO_2e) provide a universal standard of measurement against which the impacts of releasing different green house gases (GHGs) can be evaluated. Every GHG has a Global Warming Potential (GWP), a measurement that describes its effect on climate change relative to a similar amount of CO_2.

The Kyoto Protocol specifies greenhouse gases (GHG) emission reduction targets for 38 industrialized countries, including 11 countries in Central and Eastern Europe. The Joint Implementation clean development mechanism and emission trading outlined in Article 6 of the Protocol, allows these countries to jointly implement emission reduction projects, with the investing country then be able to "Credit" the reduction against their own reduction obligations.

Emission reduction credits are generated by specific and identifiable actions taken to reduce green house gases (GHG) emissions. This reduction must be quantiable by acceptable transparent and replicable calculation methodology

In this context Central America as a region (Guatemala) has the opportunity to present climate change mitigation projects in which the geothermal projects could be considered due that the energy source is benign to the environment.

A Joint Implementation Office in Guatemala has been established (OJIC), to implement the renewable projects under this mechanism. At present two renewable projects has been approved, Matanzas and Margarita hydroelectric projects.

Surveys have been carried out with the aim of showing the environmental advantage from geothermal energy in mitigation the global change. (International Geothermal Association (2002) they suggested that the natural emission rate predevelopment be subtracted from that released from the geothermal operation. Although is known that the associated carbon dioxide CO_2 emissions of generating electricity in geothermal plant are typically 1000 times less than that of gas fired plant, 1600 times less than an oil fired plant, and as much as 1800 times less than coal fired plant. **Table 1.**

4. CONCLUSIONS

The Mayas knew the geothermal resources as part of the nature and associated them to religious ritual, actually the descendents still use as sacrifice to God.

The use of the geothermal energy for bathing is, since old times used by the rural population as curative and could be a developed industry if the resources are exploited.

The Guatemalan government is encouraging private investors to take part as developers of the renewable projects including the geothermal energy by the emission of the law of incentives to develop the renewable resources projects in which the reduction emission certificate could be a benefit to the investor and at the same time will help to the environment.

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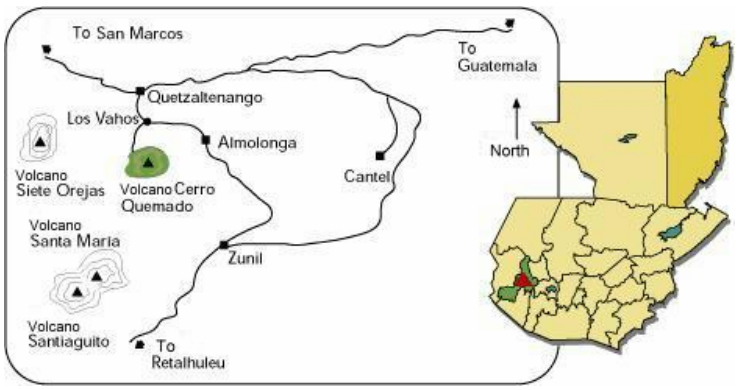

Figure 1

Figure 2 – Climbing Cerro

Table 1. Emission for power generation. Source "Let's think about energy in Japan (mar 2003) by the Agency for Natural Resources and Energy.

<CO_2 Emissions for Power Generation>	
Category	**CO_2 Emissions (g-CO_2/kWh)**
Coal Thermal	975.2
Oil Thermal	742.1
LNG Thermal(steam power)	607.6
LNG Thermal(combined cycle)	518.8
Nuclear	21.6 ~ 24.7
Hydroelectric	11.3
Geothermal	15
Photovoltaic	53.4
Wind Power	29.5