

Geothermal Projects in El Salvador and its Environmental and Social Aspects

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Contents

- Location of El Salvador
- Briefly history of LaGeo and the geothermal development
- Geothermal project stages
- Corporate social responsibility
- Legal framework
- Environmental and Social issues

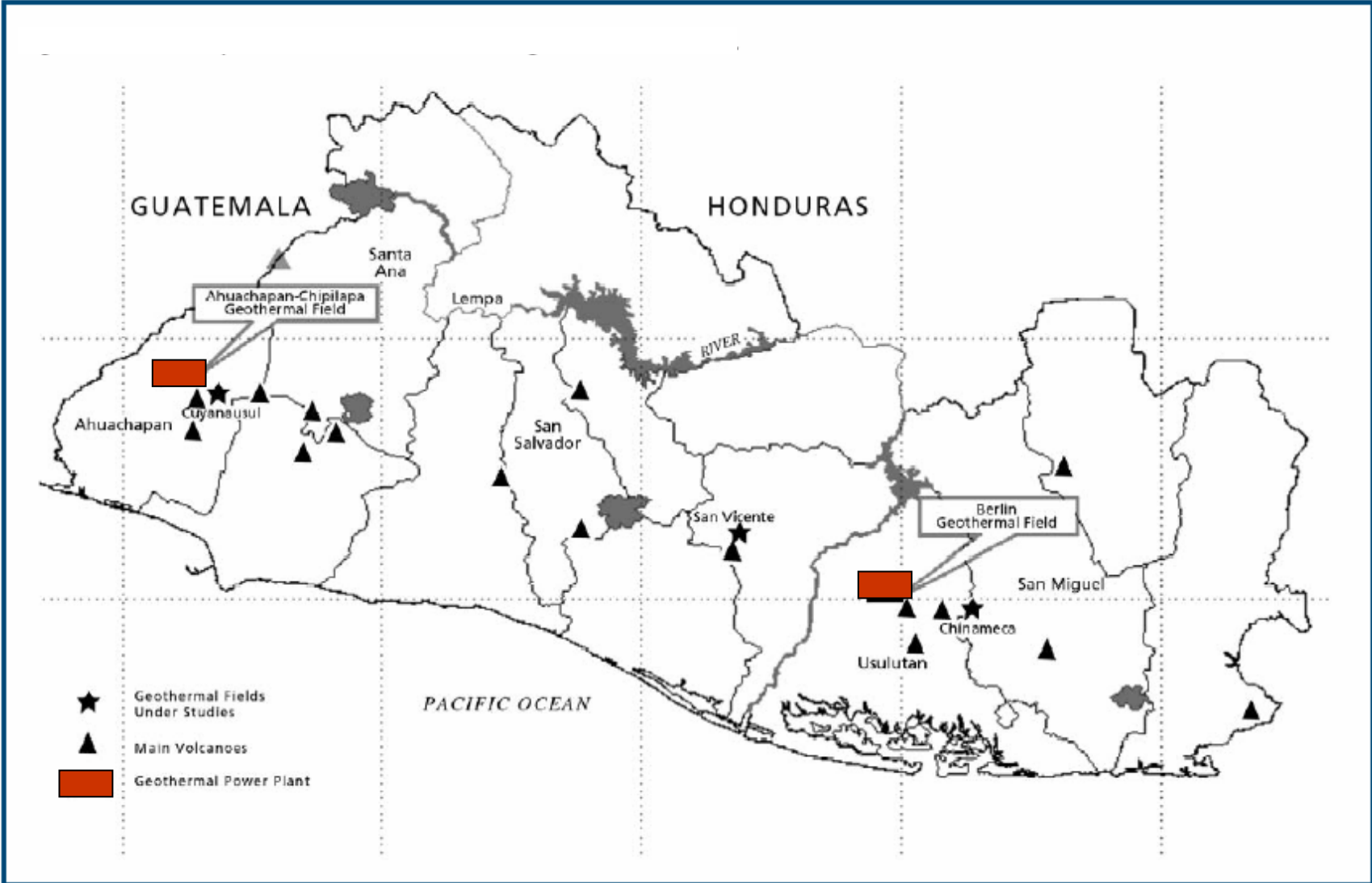
Central America countries



Power Electricity year 2006

Countries	6	
Installed Capacity	9,267.6	MW
Net Generation	35,758.6	GWh
GEO Generation	2,696.9	GWh
GEO Installed Capacity	446.5	MW
% GEO Generation	7.5	%
Peak Demand	6,225.1	MW
Load Growth	4.6	% annual

Location of Geothermal Projects in El Salvador



Source: Grupo de Trabajo de Planificación de la Operación (GTPO)



The Ahuachapan Power plant

- The Ahuachapan field is located in the Apaneca volcanic chain where the coffee plantations are the more important economic activity of the area
- The actual installed capacity is 95 MW and started the operation in 1975.
- 150 kg/s @ 5bar steam is produced by 17 wells.
- The brine is pumping through 24" x 5 km pipeline to 4 injection wells at Chipilapa area.



The Berlin Power Plant

- The Berlin field is located in the Tecapa volcanic chain where coffee plantations are the most important economic activity.
- The installed capacity is 109 MW
- 200 kg/s @ 6-9 bar is produced by 12 wells
- The brine is injected in 17 wells by gravity. A pumping system is under construction

Brief history

- Late 1950/1963 – first exploration efforts w/ German cooperation, geologic mapping
- 1963 – Fritz Dürr gives first report on geothermal potential for electricity to CEL (National Authority for Electricity Production)
- 1968 – first deep wells drilled
- 1975 – Ahuachapán Unit 1 commissioned
- 1980-1992 – civil conflict
- 1992 – Berlín wellhead development
- 1996 – electricity reform
- 1998 – geothermal division in CEL
- 1999 – LaGeo separated from CEL, Berlín condensing plant commissioned
- 2003- Partnership with ENEL from Italy
- Awarded two concession in Nicaragua and started to work as operator of San Jacinto Tizate power plant Nicaragua

Geothermal project stage

**EIA
PRELIMINARY**



**Deep drilling
exploration**



**Commercial
drilling and
rejection wells**



**Pipelines system
conecction**



**Geothermal power
plant operation**

**Turbine and auxiliars
equipments instalation**



**Geology,
Geophysical
and
geochemistry
survey**

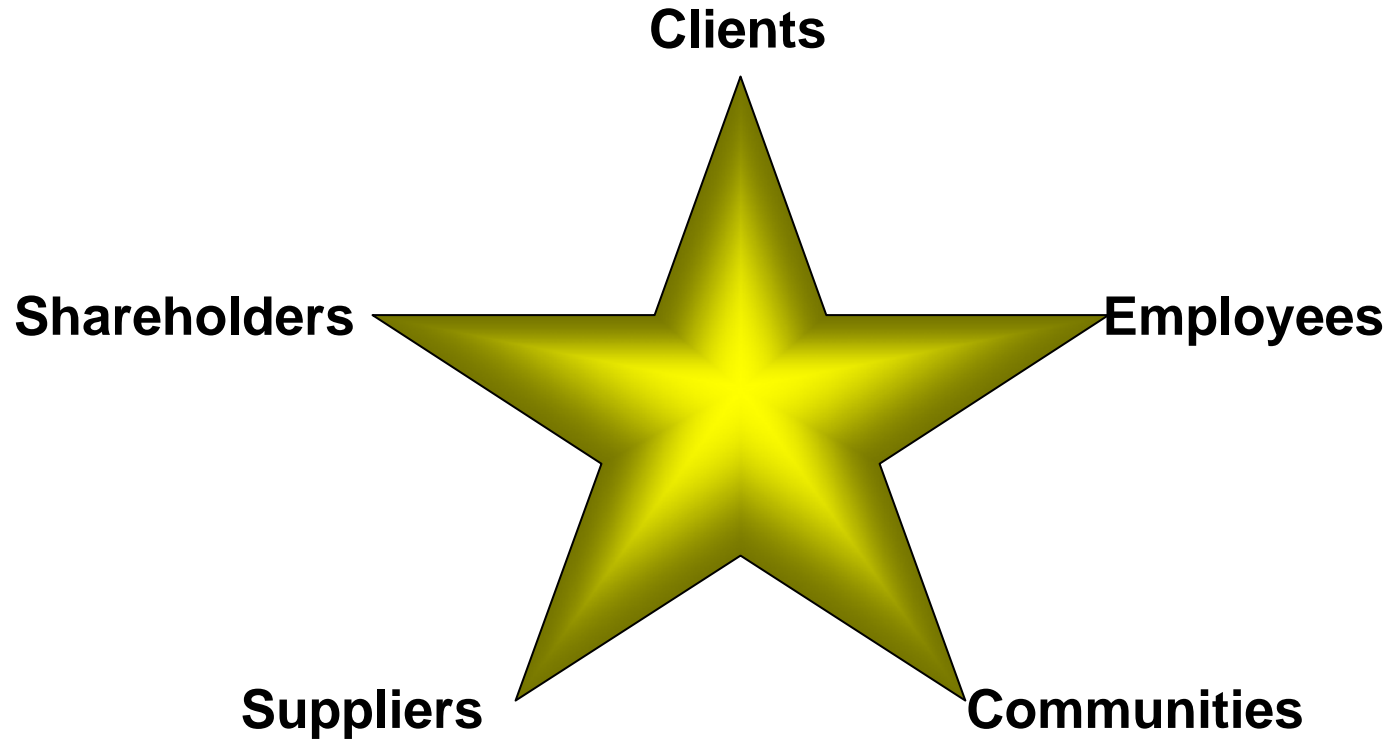


**BASELINE
STUDIES**

ENVIRONMENTAL IMPACT ASSESSMENT

**QUALITY AIR, WATER, AND SOIL
MONITORING PROGRAMME**

LaGeo Corporate Social Responsibility



LaGeo Corporate Values

- Prosperity
 - Justice
 - Culture
 - Service
 - Integrity
 - Respect for the environment
 - Passion
-
- NOTE: most of these values are in crisis in modern Salvadoran society (as in many other parts of the world)

LaGeo Corporate Values

Service



Justice



Culture



Culture



Protect the environment



LaGeo Corporate Values



Teamwork



Service

Environmental Legal framework



Environmental Impact Assessment

(EIA): Tool that allows selection of the alternative that best guarantees the protection of the environment when a project is designed and executed.

- **Environmental Permit:** Obliges the owner to take preventive, attenuative, or compensative action.



- **1989 :** Agreement for the Central American Environmental and Development Commission (CCAD). Endorsed by UN
- **1997:** MARN was created, their vision is “to direct an effective environmental management through policies and norms and facilitate the sustainable development of Salvadoran society”
- **1998:** Environmental Law approved
- **2000:** National environment policy

Electricity Legal framework

SIGET

- **Before 1996:** CEL, vertically integrated monopoly
- **1996:** Reform, is created the SIGET
- **2003:** more power to SIGET
- **2007:** Reform to market structure (marginal variable cost)

Requierevements to award the concession of geothermal areas for electricity production

- Feasibility Study
- Approved environmental impact assessment document
- Public hearing
- The process must be as public bidding
- Compromise of sustainable exploitation
- Annual Report after the concession is awarded

Environmental and Social management

Before the exploration phase an environmental base line study is normally done



During public consult several meetings with communities and municipality authorities are carried out, these data are part of the EIA study



Social and environmental projects

To construct the pad and road the physical conditions of the whole are must be carefully considered



To protect the environment and the communities several mitigation measures must be do.



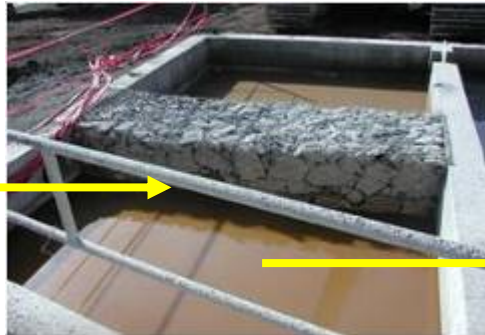
Social and environmental projects



The drilling operations are the main activity which affect the public acceptance of the geothermal project



Solid and liquid waste management drilling wells



To protect the almost extinted wildlife a protection system is in process now in Ahuachapan and Berlin power plant



Integration with communities

Geothermal Education



Ahuachapán

- 12 Communities :
9,487 inhabitants

Berlín

- 14 Communities:
10,250 inhabitants

Integration with communities

- “Window to the World”, free access to computer education for local students
- Bananas farm with communities



Clean Development Mechanism

- Independent Audit process



34 NACIÓN SOCIAL WWW.LAPRENSAGRAFICA.COM VIERNES 26 DE MAYO DE 2006

Kioto acepta un proyecto de LaGeo

Segundo proyecto del país

» Naciones Unidas registró ayer bajo el Protocolo de Kioto el proyecto que LaGeo ejecuta en Berlín.

44 megavatios de energía renovable

La noticia llega en una coyuntura en la que la factura petrolera golpea. Los 44 MW que generará LaGeo con este proyecto evitarán que esa energía se tenga que producir mediante la combustión de derivados del petróleo.

• El proyecto consiste en perforar pozos que permitan extraer vapor de la tierra que hace girar turbinas. Ese movimiento es el que permite generar la energía eléctrica.

• La construcción de la planta en Berlín, Usulután, ya lleva un avance del 75%. Se espera que comience a funcionar en septiembre de este mismo año.

• Se calcula que con siete años de funcionamiento evitará que se despidan a la atmósfera un millón de toneladas de dióxido de carbono.

de largo plazo, que al final, además

An aerial photograph of a large-scale industrial construction site. The site is filled with complex scaffolding, concrete structures, and various pieces of machinery. Thick white smoke or steam is rising from several points within the facility, partially obscuring the view. The surrounding area appears to be a mix of natural terrain and developed infrastructure.

LaGeo is receiving certificates for carbon reduction emissions

Conclusions

- The environmental and social impacts of a geothermal projects must not be overlooked and indeed should be considered as an integral part of project design
- Economic rewards of the Corporate Social Responsibility Policy are possible, but are not the driving force behind the policy.

