LECTURE 1

GEOTHERMAL DEVELOPMENTS IN CENTRAL AMERICA

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ABSTRACT

Central America has geothermal potential all along the Pacific coast, due to volcanic activity. Currently, more than 400 MWe are being exploited commercially, and there are projects ongoing to bring another 200 MWe online in the next few years. However, the demand growth and the possibility to construct large projects and transport electricity through the regional interconnector (SIEPAC) have made it possible for all the countries to plan large hydro projects to meet demand.

1. REGIONAL DATA

Central America, historically and as considered in this study, consists of six countries: Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama. Belize is not considered, as it is historically, politically, and culturally different, its electricity grid is not interconnected to the rest of the countries, it is not part of the SIEPAC project, and it seemingly has no geothermal potential.

The population of the region is approximately 39 million, over an area of 501,000 km². The total GDP of the region is $98.4 billion, for an average per capita GDP of $2,557. There are vast economic and social differences among the neighbouring countries.

The Pacific coast of the region is situated along the “ring of fire”, where the Cocos plate is subducting under the Caribbean plate. This tectonic activity gives rise to a volcanic chain along the Pacific Rim, from Guatemala to Northern Costa Rica, where the geothermal potential is concentrated. As Honduras has a very small Pacific coast along the Gulf of Fonseca, and Panama is in a tectonically distinct setting, these two countries are generally regarded as having much less geothermal potential than their other four neighbours, and most of that in low-temperature resources.

Aside from small-scale fruit drying projects and tourism developments, very little direct use is made of geothermal heat in the region, and economic resources dedicated to geothermal are highly concentrated on power projects, so it is for this reason that the present study will discuss electricity generation almost exclusively.

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 (Figures 1 and 2). These average statistics, however, hide the sharp differences in the composition of generation from one country to another: Costa Rica produces renewable energy almost exclusively, and on the other hand Nicaragua, the country with the largest geothermal potential in the region, relies on thermal sources for 80% of its electricity. It should be pointed out that, although the margin between reported available capacity and peak demand is seemingly comfortable, there has been severe electricity rationing in 2006 and 2007 in Nicaragua and Costa Rica, and Honduras and El Salvador have reported very slim operating margins, specifically during dry season. Furthermore, international power trade has dropped to roughly 15% of what it once was, due, largely, to the fact that surplus power now commands a high price, and local governments have moved to ensure supply in their own country by making exports more difficult.

Given the accelerated rate of growth of electricity demand, and the fact that there is only minor local production of fossil fuels in Guatemala, the region faces difficult choices to increase the supply of electricity in the future. The recent rise in the price of oil combined with a strong dependence on oil-based generation, have put upward pressure on electricity tariffs, which are unlikely to drop significantly in the near future. Most of the countries in the region consider a national strategy to develop indigenous sources of electricity in order to reduce their dependence on imported fuel, and so investors are favoured with different types of incentives to develop hydro, wind, and geothermal energies.

2. DIRECT USE

Most direct use of geothermal heat in the region is informal, as a substitute for firewood to cook small meals. There are two formal projects that are worthy of note: Eco-Fruit in Guatemala, and Tabacón in Costa Rica. Eco-Fruit is a brand name of Agro-Industrias La Laguna, that produces dried fruit products using heat from shallow (125 m deep) hot water wells near Lake Amatitlán, with reservoir temperature of 125°C. Tabacón is a luxury resort/spa built on the side of Arenal volcano, located where warm and cold water streams come together.
Since there is no need in Central America for space heating, widespread use of geothermal for other than electricity production is unlikely in the future.

3. POWER PROJECTS

There are seven geothermal power plants in operation in Central America. In Guatemala, Ormat owns and operates the 27.8 MW Zunil binary cycle project and the 20 MW Calderas project in the Amatitlán resource (Figure 3).

In El Salvador, LaGeo owns and operates the 95 MW Ahuachapán double flash power plant, and the 109 MW Berlín single flash facility with bottoming cycle (Figure 4). In addition, two other fields, San Vicente and Chinameca, have been awarded in concession to San Vicente 7, a subsidiary of LaGeo, and exploration work is under way. Recent drilling results for San Vicente cast doubt on the economic viability of a power generation project there.

Nicaragua has two working power plants: Momotombo (70 MW single flash + 7.5 MW binary), owned by the government and operated by Ormat, and San Jacinto Tizate (10 MW backpressure), owned by Polaris (Figure 5). Polaris has announced the future expansion of capacity at San Jacinto, to 32 MW. The El Hoyo-Monte Galán and Managua-Chiltepe geothermal areas have been awarded in concession to GeoNica, a joint venture company between Enel of Italy and LaGeo of El Salvador, and are currently in the exploration stage.
Honduras, though having little geothermal potential in comparison with its neighbours, has contracting the development of Platanares geothermal area, to GeoPlatanares, possibly suitable for a low-temperature binary cycle development (Figure 6).

The electricity sector in Costa Rica is run by ICE, the state-owned utility company, which operates most of the 160.5 MW Miravalles geothermal project (Figure 7). Of this, all is owned and operated by ICE, except the 27.5 MW Miravalles III unit, which is under a BOT contract with Mesoamerica Group. Additional exploration work is under way in Las Pailas, NW of Miravalles.

In Panamá (Figure 8), there has been some exploration work done, however, none has proceeded to further development.

In total, there are 490.5 MW of geothermal installed capacity in Central America, of which approximately 405.0 MW are available.

Estimates for the geothermal power capacity for the whole of Central America vary considerably, but conservative estimates are for about 2,000 MW of high-temperature hydrothermal electricity production in total. This means that the installed capacity of geothermal power in Central America could quadruple using currently available technology.

4. THE FUTURE

As the price of a barrel of oil increases, the need to develop alternative sources of electricity accentuates, and in response, most countries in the region offer potential investors incentives to develop geothermal energy projects. These are, for example, tax exemptions for 10 years
(Guatemala), and preferential treatment in power purchase tenders, in the form of a 5% price advantage (Panama).

The annual growth of about 5% for the regional demand means there is need for about 300 MW of new capacity each year. The GTPO, a meeting of the electric system operators of each country, expects that most of the supply growth in the next decade will come from new hydro plants, with some of the geothermal projects currently in exploration stage expected to come on line. Although there is a projection of growth based mostly on renewables, there are still large thermal projects expected to be constructed, like a large coal plant in Cutuco, El Salvador.

The SIEPAC project is projected to be completed in 2009, and that also will have an impact on the electricity markets. It consists of a 1,790 km long transmission line of 230 kV, with the capacity to transport 300 MW. This line will enable large scale power exchanges between neighbouring countries, and thus make regional generation projects more feasible.

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<tr>
<th>Country</th>
<th>Future Project</th>
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<tr>
<td>Honduras</td>
<td>* Geo Platanares, 35 MW. In process a drilling contract with PSB.</td>
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| El Salvador | * Binary Cycle of Berlin will begin in August 2007.  
* Optimization Ahuachapán is under way and there are already tangible results.  
* In exploration San Vicente and Chinameca fields. |
| Costa Rica  | * Las Pailas 35 MW Programmed in 2011 |
| Nicaragua   | * Polaris Geothermal 35 MW |
| Guatemala   | * Amatitlan from 20 to 50 MW |

FIGURE 9: Geothermal projects

REFERENCES


GTPO, 2006: *Grupo de Trabajo de Planificación de la Operación (GTPO).*

CEAC. 2005: *Consejo de Electrificación de América Central, (CEAC).*