

GEOHERMAL RESOURCES DEVELOPMENT IN CENTRAL AMERICA

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1. THE REGION

Central America, as considered in this paper, 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 and its electricity grid is not interconnected to the rest of the countries nor it is part of the “Sistema de Interconexión Eléctrica de América Central” (SIEPAC) project and it apparently has no geothermal energy potential.

The population of the region is 38.5 million in an area of 501,000 km². The Total Gross Domestic Product (GDP) is \$98.4 billion for an average per capita GDP of \$2,557, which shows vast economic differences among the neighboring countries.

The coastal region is situated along the “Circumpacific ring of fire”, where the Cocos plate is subducting under the Caribbean plate. This tectonic activity has produced an extensive volcanic chain along the Pacific rim, from Guatemala to Northern Costa Rica, where geothermal resources are concentrated. Since Honduras has a very small Pacific coast along the Gulf of Fonseca and Panama is within a distinct tectonic setting, these two countries are generally regarded as having lesser geothermal potential than the rest of the region, where most of the geothermal areas are of low-temperature resources.

Aside from small-scale fruit drying projects and tourism development, direct use from geothermal is limited in the region and viable economic resources dedicated to geothermal are highly concentrated on power generating projects. It is the object of this study to discuss mainly the electricity generation through geothermal energy.

The total installed capacity of electrical power in Central America is 8,890 MW with a maximum available capacity of 7,300 MW (variable). The peak load is 5,170 MW, with an average power growth rate of 6%/year. Annual generation in 2005 was 34,272 GWh, with 2,500 GWh (7.3%) coming from geothermal power plants, compared to 13,350 GWh (39%) produced from thermal plants, and the rest from hydro and cogeneration. These average statistics, however, present significant differences in the energy mix from one country to another: Costa Rica produces almost exclusively renewable energy while Nicaragua relies on 75% of thermal sources.

It should be pointed out that, although the margin between reported available capacity and peak demand is seemingly sufficient, there has been severe electricity rationing in 2006 in Nicaragua. Honduras and El Salvador have reported very slight operating margins, especially during dry season. Furthermore, international power trade has dropped to roughly 15% of what it was once, mainly due to the fact that surplus power at present regulates a high price.

Given the accelerated growth rate of electricity demand and the fact that there is only minor local production of fossil fuels in Guatemala, the region faces difficult options 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 immense 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, hence investors are privileged with different types of incentives to develop hydro, wind, and geothermal energy.

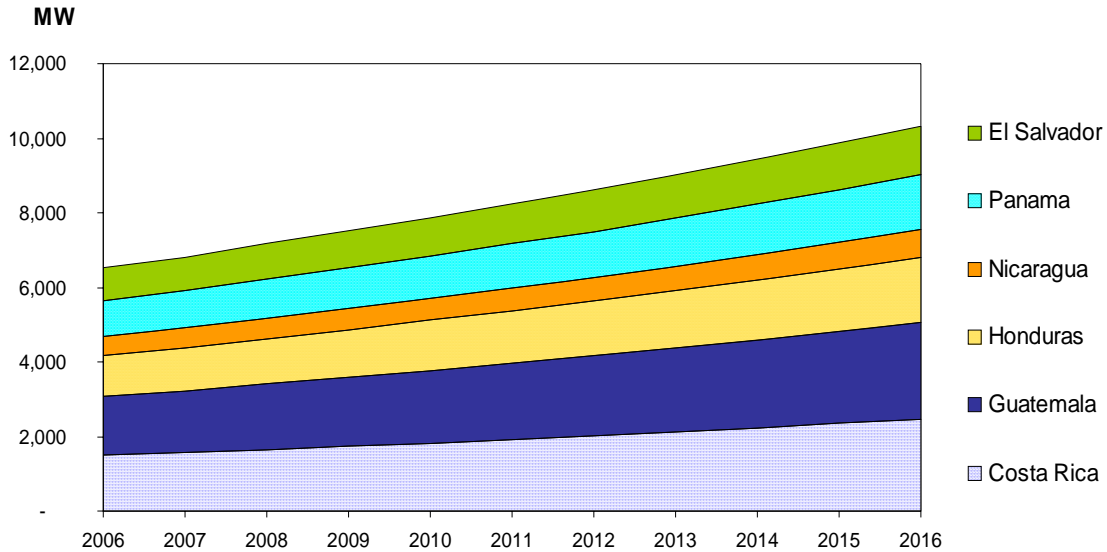


FIGURE 1: Demand Forecast (2006-2016)

2. DIRECT USE

Most of the direct use of geothermal heat in the region is informal, mainly as a substitute of firewood to cook food. There are two formal projects that are worth mentioning: 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 hot water wells (125 m depth) near lake Amatitlán, with a reservoir temperature of 125°C. Tabacón is a luxury resort/spa built on the flanks of Arenal volcano, where warm and cold-water springs merge.

Since there is no need in Central America for space heating, widespread use of geothermal energy other than electricity production is unlikely in the future.

3. POWER PROJECTS

There are six geothermal power plants in operation in Central America and one under construction. In Guatemala, Ormat owns and operates the 24 MW Zunil binary cycle project and is constructing the 20 MW Calderas project in the Amatitlán resource.

In El Salvador, LaGeo owns and operates the 95 MW Ahuachapán double flash power plants and the 56 MW Berlín single flash facilities. At present, the Berlín power plant is being expanded: One 40 MW single-flash unit is scheduled to come on line in October 2006?, and a 9.2 MW bottoming binary unit in March 2007. In addition, two other fields, San Vicente and Chinameca, have been awarded in concession to San Vicente 7, a subsidiary of LaGeo and exploration activities is under way.

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. 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 three other concession areas are currently being tendered.

Honduras, though having little geothermal potential in comparison with its neighbors, is contracting the operation of Platanares, Azacualpa, Sambo Creek and Pavana geothermal areas to GeoPower Corp. These may be suitable for a low-temperature binary cycle development.

ICE, the state-owned utility company, which operates most of the 162.5 MW Miravalles geothermal project, runs the electricity sector in Costa Rica. Of this, all is owned and operated by ICE, except the 30 MW Miravalles III unit, which is under a BOT contract with Marubeni and Oxbow. Additional exploration work is under way in Las Pailas and Borinquén, NW of Miravalles.

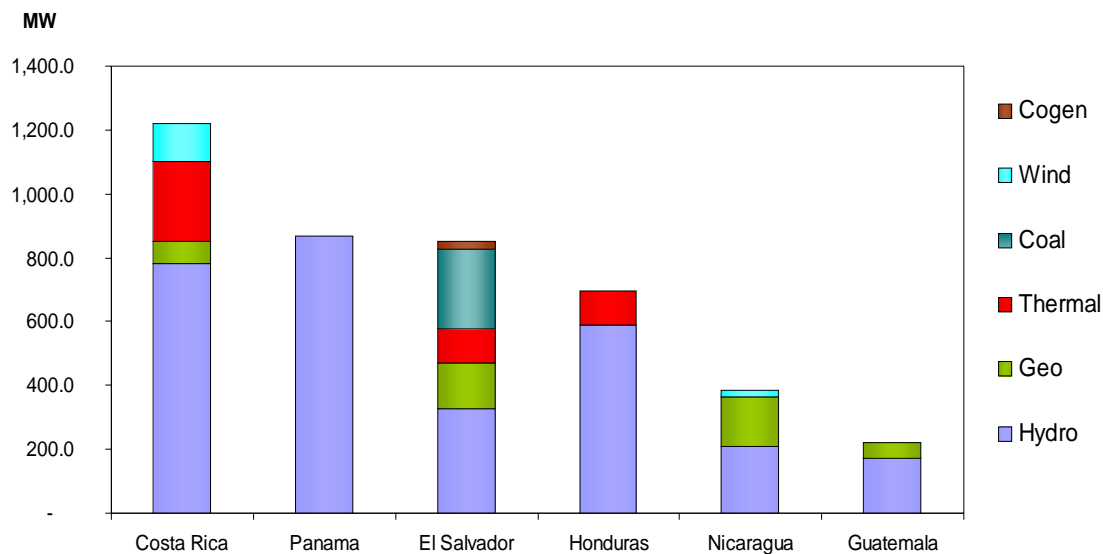


FIGURE 2: Additional Capacity (2006-2016)

*Figure 2: Projects reported to GTPO 2006.

In Panama, there has been some exploration work done, however, none has proceeded to further development.

In total, there are 445 MW of geothermal installed capacity in Central America, of which approximately 360 MW are available. There is an additional 70 MW under construction, plus work is being done to recover some of the unavailable capacity.

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 6% for the regional demand means there is a 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 renewable, 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 2008, and that will also 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 neighboring countries, and thus make regional generation projects more feasible.

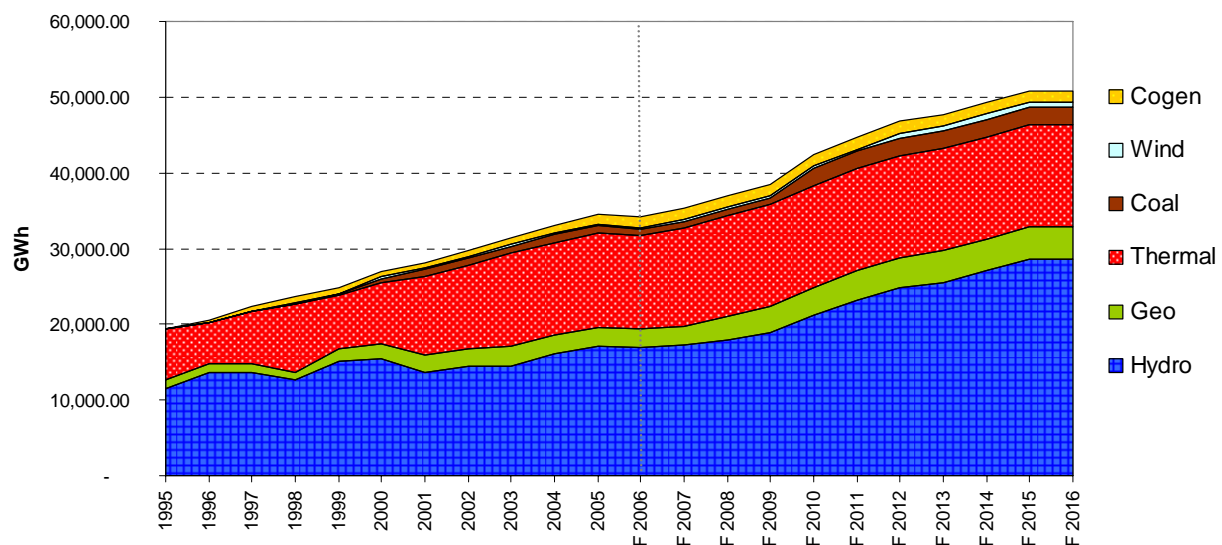


FIGURE 3: Net Generation by Resource (1995- F 2016)

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