

EXPERIENCE OF ENEL IN GEOTHERMAL DEVELOPMENT IN CENTRAL AMERICA

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ABSTRACT

Enel is the third largest listed utility in Europe with a market capitalisation of EUR 41 billion, with a strong commitment to invest and grow its renewable energy activities internationally. Since many years Enel is among the world leaders in geothermal energy development operating 32 power plants with a total installed capacity of 711 MWe In Italy .

Through the years Enel has acquired in-depth knowledge and skills in all aspects of geothermal development and production process, becoming a vertically-integrated operator with know-how on exploration, drilling, power plant design, erection, operation and maintenance. Nowadays Enel is continuing the geothermal development in Italy and is also focused on expanding its geothermal portfolio worldwide, leveraging on the technological advantage and its financial capacity. A priority area for such expansion is certainly Latin America, where a high potential of geothermal sources exists and Enel is committed to develop geothermal projects in El Salvador, Nicaragua and Chile, allowing improving the host country energy mix. Outstanding is the Enel presence in El Salvador where a strategic partnership with Comision Ejecutiva Hidroeletrica del Rio Lempa (CEL) has been achieved through an international bid on June 2002. The completion of the 40 MWe Berlin III on-going project will be contributed to LaGeo allowing Enel to increase its participation over 36%. LaGeo has already planned to carry out a number of development projects in order to reach the leading position on the geothermal energy generation in Central America. This allows Enel to implement its geothermal development plan in the region through the technical support of LaGeo regarding the exploration of new prospects as well as the construction and operation of new power plants.

1. INTRODUCTION

The first evidence of the organized use of geothermal sources comes up with the discovery of a large public bathing complex in the Sasso Pisano area of Tuscany which dates from the Etrusco-Roman times (3rd century BC) and remained in use for about 200 hundred years.

Geothermal energy production began in the area of Larderello (in southern Tuscany), where in 1817 a small group of entrepreneurs formed the first geothermal firm starting the extraction of boric acid by

evaporation of the waters of the many geothermal lagoons present in the Larderello region. On July 4, 1904, a local nobleman, Prince Piero Ginori Conti, used the steam to run a rudimentary generator and generated enough electricity to turn on five light bulbs. Nine years later, the region's first geothermal power plant went into operation. By 1944, there were five geothermal power plants in the region with a total installed capacity of 127 MWe.

For the last 40 years, Enel has continued to invest in geothermal energy production in the region, extending exploration to adjoining areas, drilling new wells and constructing power plants. Today there are, in the Larderello area alone, 32 geothermal power plants in operation with a total installed capacity of 711 MWe (Fig. 1)

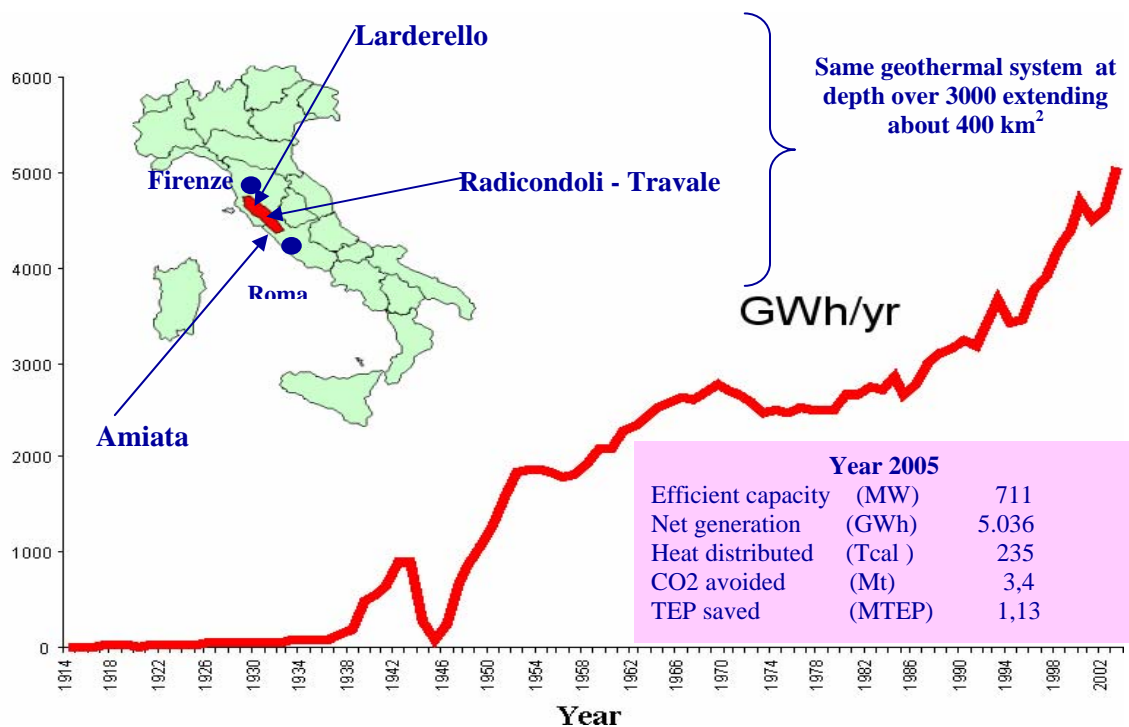


Fig. 1 – Geothermal energy production in Italy as of 2005

Enough power is produced to supply over 1.5 million families, a quarter of Tuscany's total energy requirement. It is also used to heat more than 3,000 apartments, as well as other industrial and agricultural applications, like heating greenhouses, fish farms and providing process heat.

Enel has over time acquired in-depth knowledge and skills in all aspects of geothermal energy production, placing it in the position of being a vertically-integrated operator in the geothermal sector with know-how through the whole production cycle, from exploration to drilling to plant operation and maintenance. The unique Enel's expertise on assessment and exploration of deep seated geothermal sources, involves application of 3D seismic prospecting for the location of reservoirs and of drilling technology developed to reach depths of up to 5,000 meters with temperature of about 400°C.

2. ENEL'S INTERNATIONAL ACTIVITY

Nowadays Enel is committed to develop its activities internationally for generation of electricity and distribution of electricity and gas. At present Enel owns 750 power plants with 53.161 MWe of installed capacity and 1.000.000 km of distribution network, serving more than 34 million costumers.

Over 19,000 MWe of installed capacity is from renewable sources - including wind, hydro, solar and geothermal technologies – in Italy, Spain, Latin America and North America.(Fig. 2).



Fig. 2 – Enel's international presence as of June 2006

Over the past 20 years, Enel has also been internationally active mostly in the framework of cooperation and know-how transfer programs financially supported by Italian Government, providing its geothermal expertise across to more than 15 countries, including Central America.

3. ENEL IN EL SALVADOR

The LaGeo Company is one of the four main electric generators in El Salvador, with about 20% of the installed generation capacity, (Rodríguez and Herrera, 2005) consisting mainly of two geothermal well fields and power plants (Berlin and Ahuachapán) with a total installed capacity of about 110 MWe (Fig.3).



Fig. 3 – Geothermal field under exploitation in El Salvador

During the second quarter of 2002 Enel Green Power (subsidiary of Enel S.p.A.) secured an initial stake in the La Geo Company through an international bid held by CEL. A shareholder Agreement with CEL has been signed for the execution of the first two exploration projects upon receipt of 12,5% share of LaGeo's capital of which CEL was the sole owner. Beside the initial shares subscription, the Shareholder Agreement foresees, upon a joint business decision, that Enel may finance any further investment in exchange for an additional share of LaGeo's capital. In this framework Enel decided to develop the Berlin III project and to contribute it to LaGeo thus reaching over 36% of the shares.

3.1 Berlin III project

The Berlin field has been exploited since 1998, with 21 production and reinjection wells and two units with power capacity of 28 MWe each. The geothermal reservoir is located at elevations between -1000 and -1500, with temperatures ranging 208-300 °C and 120 bar pressure. According to preliminary evaluation the field potential has been estimated enough to sustain the installation of a new generation unit of 30- 50 MWe power.

In 2003, the development of the Berlin III project has been started including:

- Reconstruction of an integrated model of the geothermal system, with the aim to assess the potential of geo-resource and locate the new wells to be drilled for production and reinjection;
- Drilling of 5 production and 3 reinjection wells, including TR-18A, the most productive well of in the country (~25 MWe dry steam at 1000 m).
- Construction of the 4,6 km steam gathering system and 5,6 km of aqueduct network.
- Construction of 44 MWe power plant, capable to generate 320 GWh/y starting from December 2006.

3.2 Other Projects

In the last four years the technicians of Enel and LaGeo had the opportunity to work together sharing their technical skills and know-how on geothermal technology in the sectors of exploration and assessment of resources and optimization of production process. This was beneficial for discovering new opportunities for organic growth of LaGeo and to generate a pipeline of new projects such as the Binary cycle unit in Berlin (9,2 MWe), the Ahuachapan Optimization and repowering (20 MWe) The exploration of San Vicente and Chinameca concessions (50-100MWe), which are now under development. Enel is evaluating to invest in these projects in exchange for additional share of LaGeo's capital.

4. ENEL IN NICARAGUA

Nicaragua has some of the largest estimated geothermal resource in Central America (Zuniga, 2005.) At the end of 2004, INE (Instituto Nacional de Energía) called an international bid for two geothermal concessions: El Hoyo-Montegalán and Managua-Chiltepe (Fig. 4).

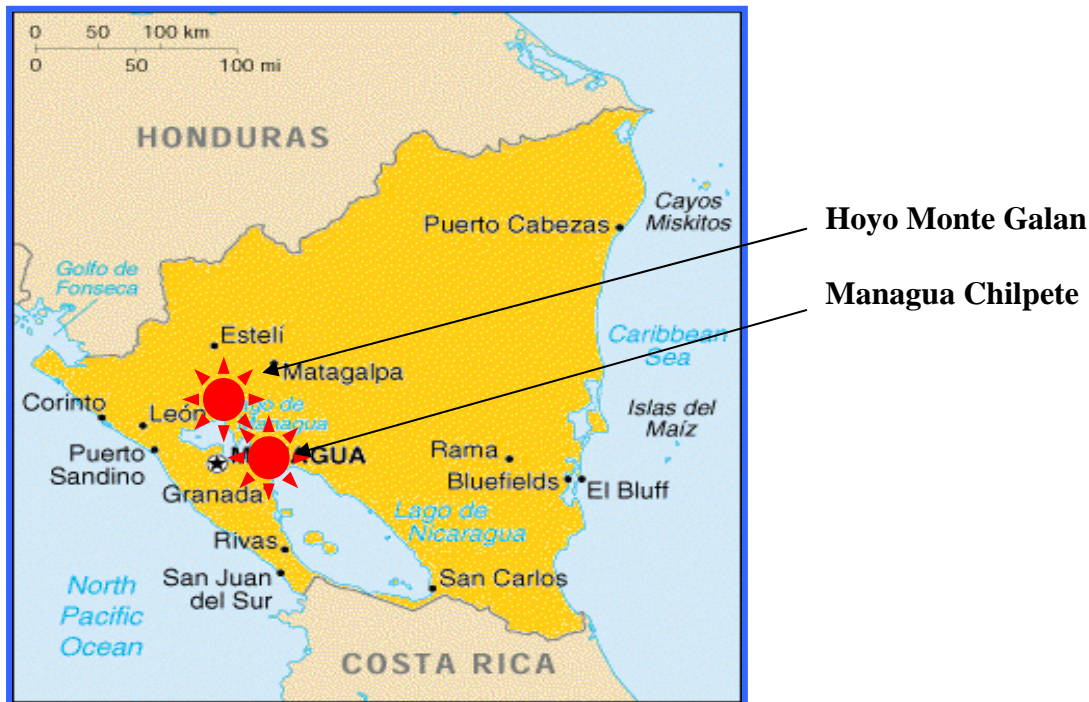


Fig. 4 – Geothermal concessions in Nicaragua

GEONICA S.A., a company in which Enel has a 60% stake with the remaining stake owned by LaGeo, was awarded the bid of the two concession. The contracts, one for each concession area, have been signed by INE and GeoNica on 6 April 2006, however INE and GEONICA agreed that the Contracts do not enter into effect until the law reform allows exploration in protected areas (which occupy up to 50% of the concession areas). The law reform was approved on September 2006 and at present environmental management plans are in preparation by Ministry of Environment and Natural Resources (MARENA).

GEONICA has been committed to carry out the exploration over an area of about 100km² for each of the two concessions. The activity consists of:

- Surface Exploration, including geological, geochemical and geophysical prospecting that will allow the construction of an integrated model of the geothermal system, with the aim to assess the potential of geo-resource and locate the exploratory wells.
- Drilling of two wells for each concession in order to verify the existence of the geothermal reserves and their power production capacity.

Exploration activity is expected to start as soon as the environmental permits are released by Nicaraguan authorities and is expected to be completed in two years.

5. CONCLUSIONS

Geothermal energy is natural and clean, like other renewable energy sources (RES) and its development plays an important role to complement existing energy production systems in Central America which is heavily dependant on fossil sfuels.

The strategic partnership with LaGeo allows Enel to implement its geothermal development plan in the region and to build a geothermal hub in El Salvador to support the development of new projects in the surrounding countries such as Nicaragua. In this framework Enel developed and contributed the Berlin III project to LaGeo reaching over 36% of shares.

All countries in Central America –except Belize- are signatories of the Kyoto protocol and most have already or are establishing the instruments for utilizing Certified Emission Reduction (CDM) mechanisms. Geothermal projects -as any RE project in the region- are eligible for obtaining CDM credits. Enel intends to maximize its support for the “flexibility mechanisms” defined in the Kyoto protocol implementation framework and the possibility of using the credits from CDM.

Some barriers could limit the growth of geothermal energy in the region, such as high development costs related to logistics, access roads and transmission lines and the risks linked to regulatory and market frameworks. However, the development of geothermal energy can play an important role in the sustainable development of the Central American region contributing to reducing the dependence on energy imports and to generate new employment opportunities.

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