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Integration of Green Technologies in Canary Islands - Low Enthalpy Geotermics

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Abstract

This paper presents the opportunities and initiatives in the use of low enthalpy geothermal resources in the Canary Islands, particularly in the construction industry. The Canaries face two problems related to electricity generation: on one hand it is an isolated system, on the other hand it is very expensive to produce electricity which mostly comes from fossil fuels. However the Canaries have favorable conditions to develop renewable energy, including shallow geothermal resources.

Keywords: renewable energy / energy efficiency / Canary Islands / building industry

INTRODUCTION

One of the most important reasons for promoting renewable energy in the Canary Islands, among which we include geothermal, is its insularity. We have total dependence on external energy resources, and therefore a great vulnerability to any energy-related crisis.

In this sense, the Canary Islands Government and other government agencies are promoting the use of renewable energy in all areas, including the building industry. In ideal conditions, the energy consumed by buildings should be balanced by the power they generate. This is the objective of the European Union on January 1, 2019: the construction of zero energy buildings, namely new buildings that produce as much energy as they consume. This energy production will have to be done by the use of renewable energy (solar, wind, geothermal, etc...)

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Figure 1. Photovoltaic plant on the island of Gran Canaria, Canary Islands

ENERGY CONSUMPTION IN THE CANARY ISLANDS

The Canarian electrical system is separated from that in mainland Spain. It is not connected to any main electrical grid and it is highly divided (Santamarta, 2013). The primary energy consumption has increased considerably in the Canaries (PECAN, 2007), with an average annual growth to 2004 of 2.9% compared to 3.2% until 2001. Hence, there is a moderating trend in growth in energy consumption.

Currently, renewable energy in the Canaries contributes only to 5% of the energy demand. This is significantly lower than the energy supplied by petroleum, namely 99.4%.

In summary, the combination of strong growth in energy consumption and CO_2 emissions in the Canaries (well above what Spain assumed under the Kyoto Protocol and subsequent distribution within the EU) will require a very active policy of efficient energy use. This implies the promotion of energy resources with low or no production of CO_2.

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Figure 2. Diesel Electrical Power Plant on the island of El Hierro, Canary Islands

The energy vulnerability of the Canary Islands is significantly larger than for the rest of Spain which, in turn, is much higher than the average of the European Union. This requires designing an energy strategy that promotes the rational use of energy and the exploitation of local energy resources at a reasonable cost.

The cost of energy generation in the Canary Islands in 2012 were (following the Canary Islands Government figures):

- Wind: 89 €/MW
- Photovoltaic: 145 €/MW
- Fossil fuel: 169 €/MW

GEOTHERMAL ENERGY IN THE CANARY ISLANDS

According to several reports of the Spanish Geological and Mining Institute (IGME, 1991), the Canaries are considered as a "geothermal region". This is due to the volcanic origin of the islands and the existence of eruptive activity in historical and recent times.

The infiltration of seawater is of particular relevance in relation to air conditioning systems of shopping centers and hotels in coastal areas. The weather, latitude and altitude of certain islands, point to a great potential for geothermal installations in isolated houses that demand air conditioning and hot water.

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Since about 1980, IGME has conducted preliminary studies about the technical and economic feasibility of the use of geothermal energy in different areas of the Canary Islands. In this sense, it was established an agreement with the national company Adaro, for geothermal exploration in the Canary Islands (Dic., 1979). Different studies, including geophysical and geochemical surveys, were conducted in Gran Canaria, Lanzarote, La Palma, La Gomera and Tenerife. The most complete study was held in the Caldera de las Cañadas del Teide in 1991. This analysis consisted on geothermal prospecting with hydrogeochemical and geovolcanical studies, air thermography at El Teide crater and geochemical and isotopic studies of El Teide fumaroles. There were different geothermal studies in the late 80´s. From all these studies, it was chosen the ideal area for drilling a deep geothermal exploration borehole. The geothermal gradient that was measured in the borehole was much lower than expected, with mean values of 4.8°C / 100m and maximum values of only 9.4°C / 100m. (IGME 1993).

All studies that have been carried out in the islands reveal that the geothermal potential is manifested in various forms on the surface. On the one hand, on islands with abundant groundwater as Tenerife and Gran Canaria, these waters reflect the existence of geothermal indicators (high temperature, high contents of silica, fluorine, boron, etc .; abundance of gases, etc.); on the other islands where there have been historic volcanic eruptions, such as Lanzarote and La Palma, there remains a high thermal anomaly linked to these eruptions, so it is possible to measure temperatures of 300-400 °C in near-surface points.

Figure 3. Thermal waters in the island of La Palma, Canary Islands

Currently, there is a project called Geothercan 2011-2014 devoted to:

- 3D modelling to characterize geothermal resources in the Canaries.
- Study 4 areas in Tenerife, 1 in Gran Canaria and 1 in La Palma El proyecto se centra en 6 zonas 4 en Tenerife, 1 en Gran Canaria y 1 en La Palma.
- Carry out structural studies in all 6 areas (ULL-PETRATHERM)

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- Carry out geochemical analysis of gases and volatiles (ITER-INVOLCAN)
- Carry out self-potential studies in all 6 areas (ITER-INVOLCAN)
- Carry out magneto-telluric studies in all 6 areas (U. BARCELONA)
- Carry out muon tomography studies (ITER-U.TOKIO)

It is intended to perform a basic geothermal research providing a solid foundation for detailed studies (geothermal boreholes). This project also attempts to define efficient innovative research tools that facilitate the development of the first geothermal project in the Canaries. Moreover, Geothercan aims to replicate this experience in other areas of Spain and other similar volcanic environments in the world.

LOW ENTHALPY GEOTHERMAL RESOURCES

Low enthalpy geothermal energy is based on the capacity of the subsoil to accumulate heat and maintain a constant temperature between 10 and 20 m deep, throughout the year. Because the heat content of low enthalpy geothermal resources is insufficient to produce electricity, those resources with temperatures below 50 ° and even 15 ° C, can be used for domestic hot water and air conditioning, through a heat pump system

There are different facilities in the Canaries that are already using low enthalpy geothermal resources for air-conditioning, pool heating and preparation of hot water (DHW). These systems save in energy costs, but they also help to reduce the emissions of CO_2.

Some local experiences are:

Tenerife:

- Installation of 30 kW. Private house

Gran Canaria:

- Proposed instalation at a shopping center in El Tablero

Fuerteventura:

- Hotel Robinson Playa.- scheduled installation
- Hotel Meliá Sparrows. Planned installation of 140 kW
- Shopping Center Las Palmeras. Corralejo. Installation of air conditioning. Installation of 1,882 kW
- Shopping Center La Rotonda. Puerto del Rosario. Refrigeration. Facilities 1,285 kW

Lanzarote:

- Arrecife Gran Hotel. Facilities include air conditioning, pool heating, thalassotherapy and ACS. Installation of 1,076 kW.
- Casino Club Náutico in Arrecife. Pool heating. Installation of 115 kW.
- Hotel Las Costas. Puerto del Carmen. Installation of air conditioning, preheating ACS and pool heating. Installation of 849 kW
- Hotel Lanzarote Village. Puerto del Carmen. Installation of air conditioning, preheating ACS and pool heating. Installation of 622 kW.

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- Floresta Apartments. Puerto del Carmen. Pool heating and air conditioning in public areas. Installation of 311 kW.
- Acualava Waterpark. Pool heating.
- More than 7,200 kW of total installed capacity.

CONCLUSIONS

The geothermal potential in the Canary Islands would be intended for use as electric power in the case of medium and high enthalpy geothermal resources. Low and very low enthalpy geothermal resources would be used in households and facilities, in particular in the tourist sector, as well as the industrial sector, namely industrial areas, desalination plants , etc ...

Regarding the level of administrative authorizations required for the installation, it is not fully standarized, especially in open systems. Hence, the corresponding technician determines the criteria to follow for approval of the installation. This leads to a high uncertainty on the authorization of the installation, lengthening the time needed for it.

In any case, there is potential for exploitation of geothermal energy in buildings in the Canaries because of the weather conditions and the particular characteristics of the resource that is available.

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