Available online at www.sciencedirect.com

SciVerse ScienceDirect

Energy Procedia 14 (2012) 1250 – 1255

Energy Procedia

2011 2nd International Conference on Advances in Energy Engineering (ICAEE 2011)

Geothermal energy sources in Santa Catarina: A prospection methodology based on 3D geo-referencing

César Ramirez Kejelin Stradiotto[a], Sonali Paula Molin Bedin[a], Tania Cristina D´Agostini Bueno[a], Hugo César Hoeschl[a], Michel Becker[b]

[a]*Instituto de Governo Eletrônico, Inteligências e Sistemas – I3G, Trindade, Florianópolis, 88036-002, Brazil*
[b]*Centrais Elétricas de Santa Catarina – CELESC, Itacorubi, Florianópolis, 88034-900, Brazil*

Abstract

This paper presents a project under deployment inside the company Centrais Elétricas de Santa Catarina – CELESC, for the development of a model intended to process information related to geothermal energy generation, in the state of Santa Catarina, Brazil. In this model, are being used techniques for knowledge management and engineering over 3D geo-referenced data. The state of Santa Catarina has known to have a great geothermal potential, with initially five geographic areas specifically identified to apply processes for heat extraction. The development of a model directed to the geothermal energy field will bring immediate benefits to the state, like a clean and sustainable energetic matrix.

Keywords: Geothermal energy, Prospection Method, Santa Catarina, Google Earth, i3G, Image Server

1. Introduction

1.1. Santa Catarina as a Geothermal Potential

A new energetic revolution is coming. As it already happened to water steam, electricity, petroleum, and, for the case of Brazil, with the pre-salt, now we are looking at arrival of geothermal energy. And every time that an energetic innovation is revealed, it is needed a cautious looking, but, in this case, the evidences are too strong. The best news tells that the state of Santa Catarina can be at a very privileged position, as a new Saudi Arabia for this new type of energy.

We also have to consider some economic impacts, due to the arrival of a new kind of energy resource: For, example, in the case of the biggest Brazilian company for petroleum production and refinement – Petrobrás – due to the discovery of pre-salt layers, on Brazilian Atlantic coast, the company value has jumped from R$65 billion to R$250 billion. So, it´s expected some kind of quantum leap on economic and financial situation of any company with deals – in any way – with this just appeared geothermal energy.

doi:10.1016/j.egypro.2011.12.1084

Looking from the environmental point of view, there are some advantages: geothermal energy does not need to be refueled, does not need to expropriate any land, it has no environmental impact for construction and operation, it´s absolutely renewable, it´s not bounded to any climatic seasonality, does not need to form lakes or artificial water fields, it does not generate catastrophic leakage, it offers low risk of accidents, and it´s main residual product is pure water. Compared to petroleum, geothermic energy has a simpler, shipper and less pollutant production.

Looking for some comparison patterns between countries, about the energy potential for future consumers, researchers at Massachusetts Institute of Technology have shown that only 2 percent of the underground heat from United States offers energy enough to supply 2500 times its actual need for energetic consumption. And for this very optimistic case, some engineering data has shown that – to accomplish this kind of supplement – it is recommended drillings until three thousand meters down the earth to take water at 150ºC.

For the case of the state of Santa Catarina, geological analysis have shown that the region has many favorable parameters to the process for generating geothermal energy: The soil is very smooth for perforation, median temperatures at soil level, and also too much abundant sources of thermal water. If it does exist external water fountains at sixty or seventy degrees Celsius, it is presumed that is easier to find water at 150oC in minor depths, characterizing a greater geothermal gradient.

Also, to help on the presumption for the geothermic potential for the geographic region, the state is known as the second source for thermal waters in the world, with sources in cities like Santo Amaro da Imperatriz, Gravatal, Itá, Piratuba and Águas Mornas (Fig. 1).

Fig. 1. Cities which present thermal waters, inside state of Santa Catarina – Brazil, indicating a wide range of geographic regions which can offers geothermal sources. Picture taken with Google Earth.

Hamza, et al. (2005) [1] apud Lund et. al. (2005) [2] "shows that currently 360.1 MWt are installed with an annual energy use of 6,622.4 TJ/yr. Of this 355.9 MWt and 6,545.4 TJ/yr are utilized for bathing and swimming, the rest (4.2 MWt and 77.0 TJ/yr) in an industrial plant, in particular for industrial wood processing and pre-heating water for use in boilers used for the production of coffee powder. About a dozen spring systems account for the bulk of this capacity with most of them located in central Brazil. The potential for large scale exploitation of low temperature geothermal water for industrial use and space heating is significant, particularly in **southern** and southeastern parts of Brazil where cold winter seasons with temperature below 10oC".

About the soil softness and water fountain temperatures, in [3] are presented the heat flow map, map of thickness of upper crust layers adopted for resource estimates, and a map for temperatures at the base of upper crust layers, for Brazil, showing the geothermic potential of Santa Catarina, as shown on Fig. 2, below: