

Ribeira Grande, 13 de Dezembro de 2011 MaReS

USE OF GEOTHERMAL RESOURCES IN THE AZORES ISLANDS: A CONTRIBUTION TO THE ENERGY SELF-SUFFICIENCY OF A REMOTE AND ISOLATED REGION



COMPANY PROFILE SOGEO - Sociedade Geotérmica dos Açores

Started its activity in 1990, following the work of previous regional government institutions in the development of geothermal projects

Capital share of 17,8 M€ owned by EDA, the power utility of the region, 50,1% still owned by the regional government

> Results in 2010 > turnover of 15,4 M€; net income 6,9 M€





COMPANY PROFILE SOGEO - Sociedade Geotérmica dos Açores



Focuses its activity on geothermal power generation, exploration of high-temperature resources and provision of waterwell drilling services

Produced over 173,5 GWh, in 2010, which represents a growth of 7,3% over the previous year

Contributed with 38,8% of the power production of São Miguel island, corresponding to 20,4% of power production in The Azores



GEOTHERMAL POWER GENERATION Origin of geothermal energy





AZORES ISLANDS Geotectonic setting – triple junction



Main tectonic structures in the Azores region: CMA – Mid Atlantic Ridge; ZFNA – Northern Azores Fault Zone; ZFEA – Eastern Azores Fault Zone; RT – Terceira Rift; FG – GLÓRIA Fault

Source: Gaspar (1996)



AZORES ISLANDS Volcanoes and geothermal manifestations





GEOTHERMAL POWER GENERATION Model of a hydrothermal reservoir



Source: GEO-DOE



AZORES ISLANDS Ribeira Grande Geothermal Field





SÃO MIGUEL GEOTHERMAL PROJECT Ribeira Grande Geothermal Field





SÃO MIGUEL GEOTHERMAL PROJECT Drilling Geothermal Wells





SÃO MIGUEL GEOTHERMAL PROJECT Ribeira Grande Geothermal Plant





SÃO MIGUEL GEOTHERMAL PROJECT Ribeira Grande Geothermal Plant





SÃO MIGUEL GEOTHERMAL PROJECT New Pico Vermelho Geothermal Plant



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GEOTHERMAL PROJECT IN SÃO MIGUEL Generation technology





SÃO MIGUEL GEOTHERMAL PROJECT Production results





AZORES ISLANDS Contribution by source of energy



Power production in the Azores still relies mainly on oil. The penetration of renewable sources grew more than five times in the last 20 years, as the result of the strategic options considered for the energy policy of the region.



SÃO MIGUEL GEOTHERMAL PROJECT Evolution of the contribution



In the last two decades, the geothermal source represented most of the effort to support the growth of the demand. With the expansion of the geothermal project, the new wind farm and the contribution from the hydro plants, renewable sources will attain clearly the majority of the generation.



GEOTHERMAL POWER GENERATION Sustainable development

"Geothermal plants provide long-term, stable, wellpaying jobs, produce nearly zero air emissions and associated health impacts, and supply millions of euros to local and state economies through decades of reliable, secure, domestic, renewable energy production."

> Adapted from "A Handbook on the Externalities, Employment, and Economics of Geothermal Energy"



SÃO MIGUEL GEOTHERMAL PROJECT Consistent operational results

Key factors:

- > Highly productive wells;
- Excess of production capacity available at the wellheads;
- > Successful application of scale inhibition.

Operating statistics for the Pico Vermelho power plant

Indicator	Unit	2009	2010	
		Actual	Forecast	Actual
Production	GWh	98.7	95.5	100.5
Average output	MW	11.3	10.9	11.5
Availability	%	99.2	99.5	99.4
Load factor ⁽¹⁾	%	112.6	109.0	114.8

1) Compared to the contracted power output

The average annual output of the Pico Vermelho plant has been approximately 15% greater than its contractual capacity. Over 15 years of consistent production provided the attribute of guaranteed power to geothermal.



SÃO MIGUEL GEOTHERMAL PROJECT High reliability and availability



The total stoppage time of the Pico Vermelho plant has been, in average, about 50 hours per year.



SÃO MIGUEL GEOTHERMAL PROJECT Base-load source of energy





Source: EDA (2011)

SÃO MIGUEL GEOTHERMAL PROJECT Recent production records



In the month of April 2011, the contribution from the geothermal source attained two historical records: was the highest ever reached and for the first time it surpassed generation from fossil fuels.



SÃO MIGUEL GEOTHERMAL PROJECT Environmentally friendly



In São Miguel, a total of 160 thousand tones of CO_2 emissions are avoided every year. Native vegetation grows within the sites of the geothermal plants, showing their compatibility with the environment.



SÃO MIGUEL GEOTHERMAL PROJECT Environmentally friendly





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SÃO MIGUEL GEOTHERMAL PROJECT Self-sufficiency comparable to references



with data from different sources



GEOTHERMAL PROJECTS IN THE AZORES CONCLUSIONS

The geothermal project in the Azores is an extremely succeeded demonstration of the advantages of the use of geothermal resources: creates high-skilled jobs, generates business locally, avoids importation of fossil fuel and is environment-friendly.

For the overall Azores region, the geothermal contribution of about 23% is comparable to the results observed in geothermal-rich countries such as Iceland, where geothermal contributes 25% to the power system.

Based on the excellent production results achieved in the last decade, it is a considered the main vector of the government policy of maximizing the utilization of renewable energy sources: 50% in 2015 is the objective.

