

BOOK REVIEW

GEOTHERMAL ENERGY RESOURCES FOR DEVELOPING COUNTRIES.

Edited by D.Chandrasekharam and J. Bundschuh. A.A. Balkema Publishers, Lisse/ Abingdon/Exton(PA)/Tokyo, 2002, 413p. Price: US\$125/-

The publication under review reflects the current global concerns and the need to encourage the use of one of the major eco-friendly energy resources like the geothermal energy, especially in the developing countries, as against the conventional fossil fuel sources that promote global warming and a decline in air quality. The inspiration for this publication springs from the initiatives of the UN Framework Convention on Climate Change (UNFCCC) and the UN Environmental Programme towards Clean Development Mechanism (CDM).

22 papers in the volume address a large spectrum of issues related to the development of geothermal energy. Subjects covered include sustainability as a technology in developing countries, financing and legislative aspects of a rather capital-intensive development, industrial and agricultural applications, exploration techniques and environmental impact. The geothermal energy sources in Central American countries and India are specifically discussed.

The first paper places the field of geothermal energy in the global perspectives of sustainability. Afgan and Carvalho focus on resource, consumption and growing future demands of energy and the definition and assessment of sustainability concepts. Aahiem and Bundschuh discuss social costs and benefits flowing from geothermal energy. While high capital costs and uncertainties in energy markets discourage investment from private sector, the clean energy that the geothermal resources offer necessitates steps by Governments to make investments more attractive. Such steps may include co-ordination of energy markets, internalizing social costs of the negative aspects of the competing conventional sources of energy, and monitoring subsidies to conventional sources. Bundschuh and Chandrasekharam discuss the large but poorly explored geothermal potential of the developing world. The high enthalpy resources required for electricity generation are situated mostly in developing countries in volcanic regions of Central and South America, including the Caribbean, Asia and the Pacific. Some of these countries can be exclusively powered by geothermal energy resources, considering the decrease in future costs (*contra to the*

statement in the abstract) compared to conventional energy, technological developments in the binary fluid methods and the potential offered by hot dry rock (HDR) resources. India, too, according to these authors, has a potential to exploit geothermal energy resources, though challenged by the very large coal resources that, however, harbour concealed costs in terms of the pollution that they generate. In a penetrative discussion, Coviello analyses the regulatory, economic and financial barriers (both project risks and market-related risks) in the development of geothermal resources. He refers to the institutional and regulatory framework that governments must evolve to attract capital outlay. Economic incentives on a scale now enjoyed by conventional energy users, such as long-term concessional loans with favourable repayment schedules, must be made available for geothermal energy development. The risks related to political aspects on the one hand and the risks in exploration and development on the other need to be overcome by Governments sharing the risk with private investors. Some of the options available include the build-operate-transfer (BOT) and the build-own-operate (BOO) projects. A regulatory framework needs to be built around a firm political will to exploit geothermal resources. An important element is the setting up of a National Geothermal Authority that will constitute a single window for the promotion and control. Several aspects of the performance of such an authority are discussed in relation to development of low to high enthalpy regimes (from 20°C onwards). The experience from geothermal operations in countries, namely Indonesia and the Philippines are outlined in terms of the BOT and BOO development models. Bundschuh and Coviello trace the non-development of geothermal energy sources to lack of capacity building through institutions, professionals and education and lack of public awareness. They emphasise the need to develop a "Learning Society" and highlight the use of Internet based technologies as low-cost communication tools. Hirsch and Rittner outline the pivotal role that can be played by the UNEP and GEF in generating a faster development. Obstacles to growth need to be addressed by generating bilateral and multilateral participation of agencies, the host

governments and the investors of funds, equipment suppliers and private geothermal energy developers.

The next six papers present a detailed account of the opportunities and constraints for specific applications. The applications include the use of small geothermal projects (<5 MW capacity) for rural electrification, direct heating in swimming pools, bathing and balneology, space conditioning, agri- and aquaculture and geothermal greenhouse cultivation. The papers introduce the reader to standard equipments and designs used.

Geochemical and geophysical methods of exploration of geothermal fields are discussed in the next four papers. Minissale outlines the need for initial reconnaissance, followed by elemental and isotopic chemical investigations and use of geophysical techniques and drilling shallow wells to measure heat gradients, a preamble for deep drilling. S.P. Verma outlines a quantitative approach, integrating geology, geochemistry and geophysics with statistical analysis and quantitative modelling. M.P. Verma gives a detailed account of fluid geochemistry. Chandrasekharam and Bundschuh scan the chemistry of both water and gas discharges that provide a pre-drilling evaluation.

A friendly energy source, not renewable in the long term, geothermal energy too has some environmental impacts. Heath emphasizes the need for environmental impact assessment in advance of development and optimization.

Bloomquist and Knapp analyse economics and financing considerations within the broad spectrum of technologies, temperature ranges, alternative conversion technologies available (space heating/district heating/industrial process heating etc) and generating options from dry steam to binary. A novelty in this paper is the self-assessment questions and answers.

Bundschuh et al. discuss the potential for development of geothermal energy resources in Central America in a region close to the Pacific and falling in the "Ring of Fire" volcanic belt, comprising Guatemala, the Honduras, El Salvador, Nicaragua, Costa Rica and Panama, that seems to be not receiving due attention. The paper presents an assessment of the environmental, economic and societal benefits in the framework of current energy markets, regionalisation of markets, current restrictions on private enterprise, future demand and expansion plans and limiting barriers, followed by a region-wise assessment.

The last section of the book updates the geothermal

scenario in Costa Rica, Mexico and India. While the first two rank high in their potential being in the "ring of fire" in Central America, the Indian scenario remains distinctive and moderate. Chandrasekharam brings to the fore the potentialities of utilizing the thermal energy resources in India in some six geothermal provinces identified. Except for the Barren Islands region that has a distinct currently active volcanic setting close to Burmese-Andaman subduction arc, the rest of the fields include the mid-continental rifts like the SONATA belt, pericontinental rifts such as Cambay basin related to Deccan Volcanism and the compressive Himalayan collision belt as at Puga-Chummahung-Manikaran belt of NW India. Perhaps one may as well distinguish the Rajmahal volcanic belt in Eastern India as a distinct field with high potential. The current status of our knowledge of the sources of heat and the host rocks involved indicate a potential to support low order (in the scale of one to possibly tens of MW) power generation and perhaps, even more extensively Hot Dry Rock (HDR) feasibility. An interesting suggestion is the potential of Himachal Pradesh for enhancing its agricultural and fruit-generating status by initiating state-of-art technology in food processing (dehydration and green house cultivation) using geothermal energy.

The publication provides a comprehensive treatment of the wide spectral span of subjects related to geothermal energy, its exploitation and industrial use. It stands out for lucidity of presentation, excellently produced numerous self-explanatory illustrations, diagrams and tables and exhaustive references. These provide the book the status of a good reference publication. It has an attractive and pleasant get up. The book should interest all those involved in the planning and development of energy resources as a whole and all those addressing energy-related problems, including policy makers, planners and financing institutions. It would be a guide-book to those involved in exploration of geothermal resources. Geochemists will find a wealth of exciting elemental and isotopic data on both liquid and gaseous components of hot springs. The book should find a place in all modern libraries, as a source book on geothermal energy.

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