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ENERGY CONSERVATION FOR THE BETTERMENT OF HUMANITY AND ENVIRONMENT THROUGH GEOTHERMAL RESOURCE

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ABSTRACT

Rapid growth of the energy sector has made environmental protection a highly complex and more difficult task. There is a pressing need for alternate sustainable supplies of energy. Geothermal resources have the potential of contributing significantly to sustainable energy use in many parts of the world. The technology, reliability, economics, and environmental acceptability of direct use of geothermal energy have been demonstrated throughout the world. Geothermal energy, its potential, recovery, present scenario of utilization and its utility as a cleaner source has been discussed.

INTRODUCTION

The demand for energy is increasing at an exponential rate due to the exponential growth of the world population. This, combined with the widespread depletion of fossil fuels and gradually emerging consciousness about environmental degradation, suggests that the energy supply in the future has to come from renewable sources of energy (Demirbas *et al.*, 2004; Balat, 2007; Balat, 2009). On the worldwide basis, geothermal energy is considered to have the largest technical potential of the renewable energy sources. Furthermore, the production price of geothermal energy is favorable as compared to all other energy sources (Stefansson, 2002; Balat, 2009). Geothermal energy is clean, cheap, and renewable, and can be utilized in various forms such as space heating and domestic hot water supply, carbon dioxide and dry ice production process, heat pumps, greenhouse heating, swimming and balneology (therapeutic baths), industrial processes, and electricity generation The technology, reliability, economics, and environmental acceptability of direct use of geothermal energy have been demonstrated throughout the world (Demirbas, 2006, Balat, 2009).

Power Generating Capacity of Indian Geothermal Provinces

India has 400 medium to high enthalpy geothermal springs, clustered in seven provinces shown in Figure 1. The most promising provinces are, The Himalaya, Sohana, Cambay, Son-Narmada-Tapi (SONATA) and the Godavari. Most of them are liquid dominated systems with one or two having both

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liquid and gas dominated systems. Table 1 summarizes the temperatures, heat flow values and geothermal gradients of the provinces.

Techniques for Production of Geothermal Energy (Douglas, 2009)

Geothermal energy exploits the natural heat of the earth to produce electricity. The various techniques currently used to produce geothermal energy include the following:

Dry Steam Plant- Dry steam plants draw steam directly from under the earth's surface to drive a generator. The steam then naturally condenses into water and is reinjected into the geothermal reservoir (Douglas, 2009).

Flash Steam Plant - Flash steam plants extract geothermal water exceeding 350°F under extremely high pressure. That steam drives a generator, after which the extracted water and steam are reinjected into the geothermal reservoir (Douglas, 2009).

Binary power Plant - In this type of power plant, the geothermal water is passed through a heat exchanger where its heat is transferred to a secondary liquid, namely isobutene, isopentane or ammonia–water mixture present in an adjacent, separate pipe (Hashizame, 2004).

Hybrid power Plant - In this system of power generation, the flashed and binary systems are combined to make use of both steam and hot water (Bhardwaj *et al.*, 2008).

Other non-electrical uses - If the geothermal reservoir is either shallow or has low temperature, then it can be used for various other purposes, i.e. aquaculture, greenhouses, health spas, space or building heating, bathing, tourism or other activities involving low-temperature water (Bhardwaj, 2008).

Geothermal Environmental Impacts

Various potential environmental impacts from any geothermal power development. These include:

Table 1: Potential Geothermal provinces of India (Chandrasekharam, 2000)

S.No	Province	Surface (T °C)	Reservoir (T °C)	Heat Flow (MW/m2)	Thermal gradient (°C/km)
1.	Himalaya	>90	260	468	100
2.	Cambay	40-90	150-175	80-93	70
3.	West coast	46-72	102-137	75-129	47-59
4.	SONATA	60-95	105-217	120-290	60-90
5.	Sohna	-	-	-	76-96
6.	Godavari	50-60	175-215	93-104	60

Table 2. Summary of Benefits and Challenges of Geothermal Energy

S.No.	Benefits	Challenges
1.	Geothermal power plants provide steady and predictable baseload power.	Many of the best potential resources are located in remote or rural areas, often on federal or state lands.
2.	Direct use applications and power plants can generate tax revenue and royalty payments for federal, tribal, state and local governments and create construction, operation, administrative and maintenance jobs.	Although costs have decreased in recent years, exploration and drilling for power production remain expensive.
3.	Responsibly managed geothermal resources can deliver energy and provide power for decades.	Using the best geothermal resources for electricity production may require an expansion or upgrade of the transmission system.
4.	Geothermal power plants in the United States are reliable, capable of operating about 98 percent of the time.	The success rate for discovering geothermal resources in new, untapped areas is approximately 20 percent. In areas where wells already are producing, the chance of locating more wells increases to about 80 percent.
5.	Power plants are small, require no fuel purchase and are compatible with agricultural land uses	The productivity of geothermal wells may decline over time. As a result, it is crucial that developers manage the geothermal resource efficiently.

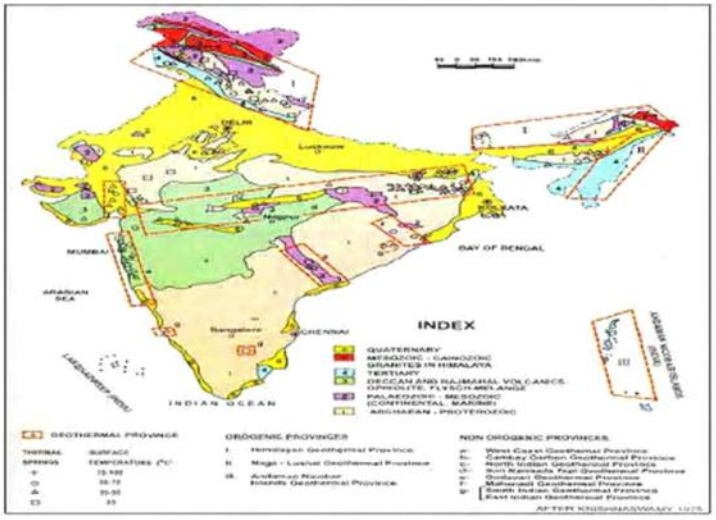
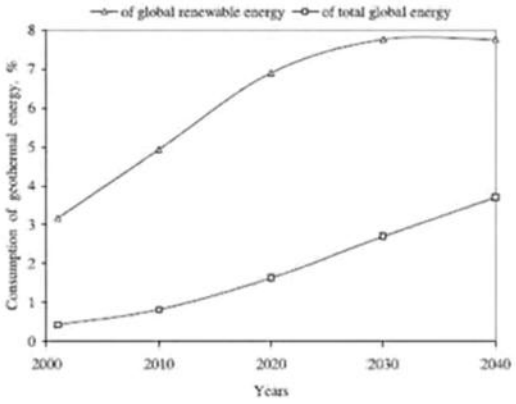


Fig. 1 Major and representative Indian geothermal provinces (Razdan, 2008)



Source: (EREC, 2006; Balat, 2009).

Fig. 2 Consumption of geothermal energy

Gaseous Emissions - For hydrothermal installations, the most common NCGs are carbon dioxide (CO_2) and hydrogen sulfide (H_2S), although species such as methane, hydrogen, sulfur dioxide, and ammonia are often encountered in low concentrations (Kagel *et al.*, 2005).

Water Pollution - Liquid streams from well drilling, stimulation, and production may contain a variety of dissolved minerals, especially for high temperature reservoirs (>230°C). Some of these dissolved minerals (e.g., boron and arsenic) could poison surface or ground waters and also harm local vegetation (Dipippo, 2005).

Solids Emissions - The only conceivable situation would be an accident associated with a fluid treatment or minerals recovery system that somehow failed

in a catastrophic manner and spewed removed solids onto the area (Kagel *et al.*, 2005).

Noise Pollution - During normal operations of a geothermal power plant, noise levels are in the 71 to 83 decibel range at a distance of 900 m (Dipippo, 20050.

Induced Seismicity - Induced seismicity in normal hydrothermal settings has not been a problem because the injection of waste fluids does not require very high pressures (Majer *et al.*, 2006).

Water Use - Water use can be managed in most cases to minimize environmental impacts. Water is required during well drilling to provide bit cooling and rock chip removal.

Disturbance of Natural Hydrothermal Manifestations - Although numerous cases can be cited of the compromising or total destruction of natural hydrothermal manifestations such as geysers, hot springs, mud pots, etc. by geothermal developments (Jones, 2006; Keam *et al.*, 2005).

Disturbance of Wildlife Habitat and Vegetation - The development of a geothermal field can involve the removal of trees and brush to facilitate the installation of the power house, substation, well pads, piping, emergency holding ponds, etc (LaGeo, 2005).

CONCLUSION

Geothermal energy is clean, cheap, and renewable. Today geothermal energy is used around the world for heating and electrical generation. Much has been made in recent times of the issue of global warming, the effect of greenhouse gas emissions, and the large contribution made by the power generation sector. Among the drives to generate sustainability, reducing emissions is most prominent. Geothermal electricity production can help reduce the need for oil imports, reducing the trade deficit and adding jobs to a country's economy. This article concludes by identifying geothermal energy as one of the potential sources of energy for maintaining a clean environment.

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