

# WORLD STATUS OF GEOTHERMAL ENERGY USE OVERVIEW 1995-1999

**John W. Lund**  
**Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, OR**

## 1. INTRODUCTION

Early humans probably used geothermal water that occurred in natural pools and hot springs for cooking, bathing and to keep warm. We have archeological evidence that the Indians of the Americas occupied sites around these geothermal resources for over 10,000 years to recuperated from battle and take refuge. Many of their oral legends describe these places and other volcanic phenomena. Recorded history shows uses by Romans, Japanese, Turks, Icelanders, Central Europeans and the Maori of New Zealand for bathing, cooking and space heating. Baths in the Roman Empire, the middle kingdom of the Chinese, and the Turkish baths of the Ottomans were some of the early uses of balneology; where, body health, hygiene and discussions were the social custom of the day. This custom has been extended to geothermal spas in Japan, Germany, Iceland, countries of the former Austro-Hungarian empire, the Americas and New Zealand.

Other early uses included the geothermal water at Huaqingchi Hot Spring in China; where, a bathing and treatment facility was built in the Qin Dynasty (over 2,000 years ago), and a hot spring at Ziaotangshan near Beijing used for recreation for about 800 years by the royal family, and other high-ranking officials in the Ming and Qing Dynasties. Early industrial applications include chemical extraction from the natural manifestations of steam, pools and mineral deposits in the Larderello region of Italy. Serious industrial activity began only after the discovery of boric acid in the hot pools in 1777. The first attempt at using these minerals was made in 1810, and nine factories were built between 1816 and 1835. A flourishing chemical industry was in operation by the early 1900's. At Chaudes-Aigues in the heart of France, the world's first geothermal district heating system was started in the 14<sup>th</sup> century and is still going strong.

As described above, we know that there have been many countries where geothermal has been used in the past, but most of this utilization has not been documented. However, a recent publication (1999): *Stories from a Heated Earth - Our Geothermal Heritage* (edited by R. Cataldi, S. Hodgson and J. Lund) describes many of these early uses prior to the industrial revolution. This publication covers more than 25 countries with historical information taken from the works of archaeologists, historians, geographers, anthropologists, scientists and engineers. Thus, we now have in a single reference documenting the early uses of geothermal energy -- from hot spring bathing to the use of geothermal material such as obsidian and tuff, along with the legends and myths associated with fumaroles, hot springs and volcanic eruption. These uses continues today with electric power generation, and space heating and cooling.

## 2. DEVELOPMENTS IN THE 20<sup>TH</sup> CENTURY

### 2.1 Electric Power Generation

The first use of geothermal energy for electric power production started in Italy with experimental work by Prince Gionori Conti between 1904 and 1905. The first power plant (250 kWe) was commissioned in 1913 at Larderello. These developments were followed by Wairakai, New Zealand in 1958; an experimental plant at Pathe, Mexico in 1959; and at The Geysers in the United States in 1960. The first international geothermal meeting to report on geothermal utilization was the UN Conference on New Sources of Energy held in Rome in 1961 where developments in Italy, New Zealand, USA and Iceland were discussed (Smith, 1964). At that time, Iceland was proposing a plant at Hveragerdi and the experimental installation at Pathe was not mentioned. This was followed by the UN Symposium on the Development and Utilization of Geothermal Resources at Pisa in 1970 (Facca, 1970). Based on these reports and subsequent reports presented at the 2<sup>nd</sup> UN Symposium on the Development and Use of Geothermal Resources at San Francisco in 1975 (Armstead, 1975a), the GRC Annual meetings (1981, 1985 and 1990) (DiPippo, 1981 and 1985; Hutterer, 1990), and at the World Geothermal Congress in Florence in 1995 (Hutterer, 1995), along with the current report by Hutterer (2000) the development of geothermal electric power is presented in Table 1.

**Table 1. Worldwide Development of Geothermal Electric Power**

Year	Installed	Energy MWe	Number GWh/yr	Participants of Countries
1940	130		1	Italy
1950	293		1	Italy
1960	386	2,600 est.	4	+ NZ, Mexico, & USA
1970	678	5,000 est	6	+ Japan & USSR
1975	1,310		8	+ Iceland & El Salvador
1980	2,110		14	+ China, Indonesia, Kenya, Turkey, Philippines, & Portugal
1985	4,764		17	+ Greece, France & Nicaragua
1990	5,832		19	+ Thailand, Argentina, & Australia - Greece
1995	6,797		20	+ Costa Rica
2000	7,974	49,261	21	+ Guatemala & Ethiopia - Argentina

Unfortunately, no estimates were made of the energy produced during the period 1975 to 1995. There also appears to be slight differences in the installed MWe numbers between various authors.