**●Прочитайте и переведите подчеркнутые абзацы в тексте. Определите видовременные формы глаголов в выделенной жирным шрифтом части текста.**

GEOTHERMAL ENERGY Introduction

**One is tempted to talk of the seven ages of geothermal development. From prehistory, natural hot springs have been used by man for bathing and cooking, and there is some evidence of piped systems as early as the 14th century, but the 8 second age – the managed exploitation of heat from the Earth – really began about one hundred years ago with the first piped heating systems in Europe and the USA. These were followed closely by the first steps in commercial power generation (as early as 1904 in Italy), which developed quietly but unspectacularly up to the time of World War II, The third age (ca. 1950–1970) was a period of slow consolidation, with systems developing slowly but – above all – with far greater detailed knowledge of the underground and its exploration emerging, primarily through the oil industry. The fourth age (1973–1980) was the golden age of geothermal energy**. Spurred by the first oil shock and with a solid foundation of geological knowledge, geothermal power stations began to appear in more than 30 countries. During this period, the growth rate of worldwide installed capacity touched 14 % per year, and averaged 8.5 %. Similar though less spectacular development occurred also in direct geothermal heating applications. Worldwide Installed Geothermal Electric Capacity Part of the reason for this enthusiastic development was the reliability of geothermal resources. Unlike the other sustainable energy sources such as wind or solar, geothermal resources provide firm power, 24 hours per day, 365 days per year. It is not unusual to find geothermal plant with annual availability factors in excess of 98 %, so load factors can be high, the energy supplied by geothermal is some 3.5 times greater than for wind plant. This firmness in itself can be a considerable asset to the utilities. By the early 1980's, however, fossil fuel supplies had stabilized and prices were falling in real terms. For a technology that required a high initial capital investment and achieved its returns in terms of saving on fossil fuels, that was bad news. Coupled with the fact that this was a period of high interest rates and that – at least in new areas –the geological risk (and hence risk to the invested capital) is high, 1985–1995 was essentially a period of stagnation for geothermal development. There is evidence that this situation is now changing, and that we may be entering into the sixth age of geothermal development – one in which the environmental and other advantages of geothermal development (by comparison with other energy sources, be they fossil or renewable) begin to be recognized by a wider public. If this is true, we can expect this sixth age to merge imperceptibly into a seventh age early in the next century when new technologies – for which the research started in the 1970's – will extend the opportunities for geothermal usage to geographically and technically wider areas. Not only are the better geothermal zones increasingly well understood, but techniques of exploration and interpretation are becoming increasingly 9 sophisticated – thanks, again, to the hydrocarbons industry which relies on essentially the same range of technologies. Geothermal's really strong point, however, is its potential to be environmentally friendly. By operating geothermal systems as a closed loop, and reinjecting the contaminants along with the cooled water, the environmental impact can be reduced almost to zero. Geothermal heat pumps, or ground-source heat pumps, for heating and cooling buildings are a rapidly growing example of a geothermal direct use application. The technology has developed almost without publicity in recent years to become a significant new factor in the supply equation. This is an electrically-based technology that allows high efficiency, reversible, watersource heat pumps to be installed in buildings in most geographical and geological locations (worldwide). The combination of increasing levels of electrical generation efficiency, with the impressive energy amplification of geothermal heat pumps means that space heating can be delivered with effective efficiencies that exceed 100 %. The «additional» energy is supplied from the ground. In addition these systems also offer highly efficient cooling. The types of buildings that are using ground-source heating and cooling in this manner range from small utility or public housing, through to very large (MW-sized) institutional or commercial buildings. This technology can offer up to 40 % reductions in CO2 emissions against competing technologies. If all of the electricity is supplied from non-fossil sources, there are no Commissions associated with heating and cooling a building. Recently, several large-scale arrays have been installed to feed larger systems where suitable supplies of deep geothermal water are not available. In the largest development to date, 4000 units – each with its own borehole – have been established on a US Army base in Louisiana to provide heating and cooling. The concept was developed independently in the US and Europe and, although Sweden and Switzerland have installed many thousands of units to provide winter heating in houses, the pace of installation in the USA and Canada during the last fifteen years has overtaken the European rate. There are now believed to be well over a quarter of a million installations in place in North America. While the main activity is currently in the USA, there are a growing number of installations in Canada, Sweden, Switzerland, Austria and Germany. Smaller numbers are being installed in other European countries, and in Australia. The Geothermal Heat Pump Consortium currently has over 750 institutional, corporate and commercial members, and 40 international members from countries including Australia, Canada, China, Croatia, Finland, Germany, India, Japan, the Netherlands, Poland, Russia, Sweden, Turkey, and the UK. 10 Ground-source heat pumps are perhaps the first indication of the seventh age of geothermal technology, breaking the final barrier of geographical availability. To sum up: geothermal technology offers many benefits – clean, indigenous, firm energy – but suffers from economic uncertainties and geographical limitations. These problems are being actively addressed and future prospects seem bright.