Geothermal energy use in Russia

Valentina Svalova
Institute of Environmental Geoscience RAS, Moscow, Russia
Email: inter@geoenv.ru

Abstract

Geothermal energy use is a way to achieve sustainable clean energy development in the world. Russia has rich high and low temperature geothermal resources and is taking good steps in this direction. The development of the present-day world is impossible without large cities. At present, urbanization has become a truly global process the rate and scale of which increases catastrophically. The gigantic concentration of people results in a multiple increase in the supplies of water, energy, and food to cities, which, along with an increased production and service, is responsible for the accumulation of a huge amount of polluted water and industrial and domestic waste in the city areas. This causes an aggravation of social, environmental, and economic problems in large cities. Under these conditions the problems of urbanization and municipal engineering take on an absolutely different social significance – they become part and parcel of the global problem of sustained development of the modern society. In this connection two important aspects could be considered: clean alternative renewable energy use and organization of environmental parks as a demonstration of preferences and advantages of such energetic supply, which is very close. The concept of environmental parks on the territories of big towns and for reserved territories is under elaboration. The choice of the optimal system for a nature-friendly energy support is based on the use of the deep-thermal energy and other ecologically pure sources, depending on the concrete conditions of the environmental park/aquapark, and takes into account all the environmental, economical and social factors. As a result the environmental passport of territories can be created. The concept of environmental parks could help to demonstrate the advantages of renewable alternative energy utilization.

***Keywords**: geothermal energy, Russia, sustainable development, environmental parks.*

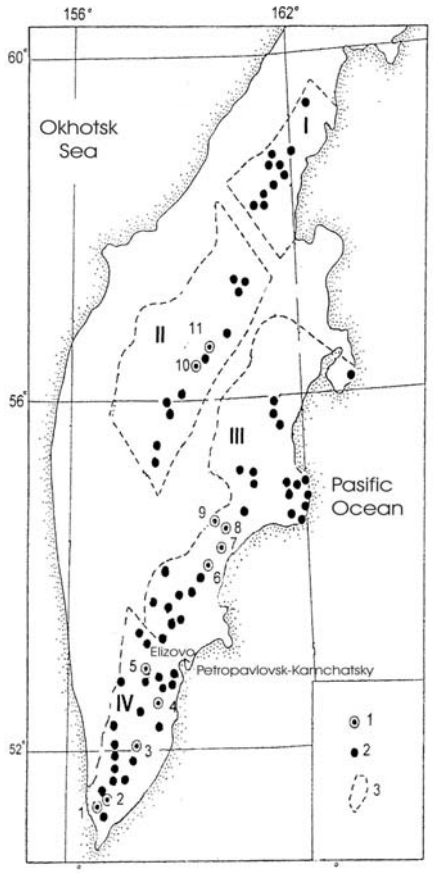
1 Introduction

In Russia geothermal research is carried out by 53 scientific centers and higher educational institutions located in different cities belonging to different offices: Academy of sciences, Ministries of education, natural resources, fuel and energy. They can be conditionally joined in some regional centres of science, such as Moscow, St. Petersburg, Northern (Archangelsk and Apatites), North-Caucasian (Makhachkala, Gelendgik, Groznij (before 1993)), Volga region (Yaroslavl, Kazan, Samara), Ural (Ufa, Ekaterinburg, Perm, Orenburg), Siberian (Novosibirsk, Tyumen, Tomsk, Irkutsk, Yakutsk), and the Far East (Khabarovsk, Vladivostok, South-Sakhalinsk, Petropavlovsk-on-Kamchatka). In such centers consisting usually of several institutes, future geothermal researches are in progress: theoretical, applied, regional, and creation of special instrumentation.

2 Geothermal energy use

In Russia, geothermal resources are used predominantly for space heating, both heating of several cities and settlements in Northern Caucasus and Kamchatka with a population of about 500.000. Moreover, in some regions of the country the deep heat is used for greenhouses of 465.000m^2 accumulative area. Most active use of the hydrothermal resources are in Krasnodar territory, Dagestan and on Kamchatka. (Fig. 1, Fig. 2) (Gadzhiev et al., 1980, Kononov et al., 2000). Approximately one half of

the extracted resources, is applied for heating of habitation and industrial buidings; a third to heat greenhouses, and about 13% for industrial processes. Besides this the thermal waters are used in approximately 150 health resorts and 40 factories that bottle mineral water. Quantity of electrical energy that is developed in geothermal power stations of Russia per 1999 has increased almost twofold. Nevertheless, it remains extremely minor, making up some 0.01 percent of the total development of the electric power in the country.



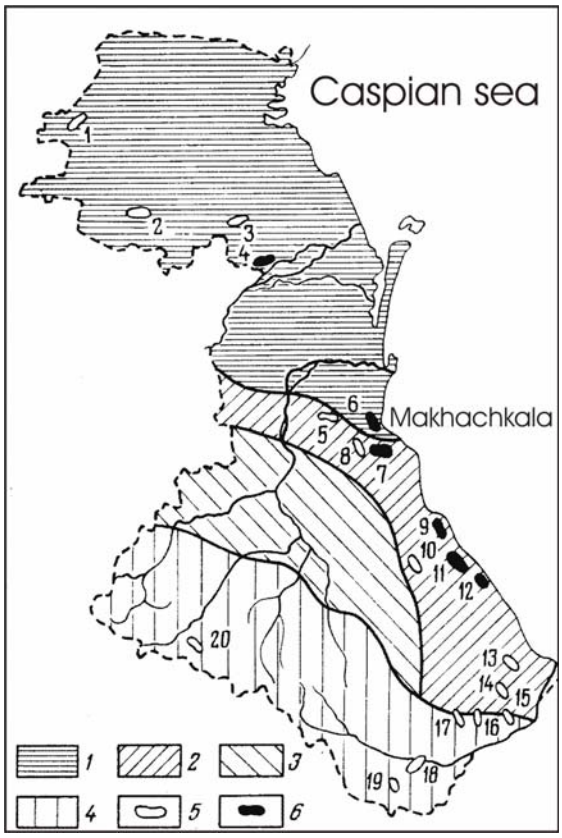


Figure 1: Geothermal resources of Kamchatka.
1 – geothermal deposits (1 – Pauzhetskoje, 2 – Nizhne-Koshelevskoje, 3 – Khodutkinskoje, 4 – North-Mutnovskoje, 5 – Big-Bannoje, 6 – Karimskoje, 7 – Semjachinskoje, 8 – Geysers Valley, 9 – Uzonskoje, 10 – Apapelskoje, 11 – Kireunskoje);
2 – groups of thermal springs;
3 – hydrogeothermal provinces (I – North, II – Middle, III – Easten, IV – South).

Figure 2: Map of hydrogeothermal deposits and perspective areas of Dagestan.
1-4 – measure (1 – Quaternary, 2 – Neogene, 3 – Cretaceous, 4 – Jurassic);
5 – perspective areas;
6 - hydrogeothermal deposits;
fingers on the map – thermal anomalies (1 – Bazhigan, 2 – Terekly-Mekteb, 3 – Tarumovka,4 – Kizljar, 5 – Istisu, 6 – Makhachkala, 7 – Talgi, 8 – Zauzanbash, 9 – Izberbash, 10 – Salgabak, 11 – Kajakent, 12 – Berikej, 13 – Belidzhy, 14 – Choshmenzin, 15 – Giljar, 16 - Adzhinaur, 17 – Richalsu, 18 – Akhty, 19 – Khnov, 20 – Khzanor.

The most important new direction that the usage of low temperature geothermal resources has taken is the use of heat pumps. This way of heating is optimal for many regions of Russia – in its European part, in the Ural and elsewhere. But only the first steps have been taken in this direction.

Electricity is generated by a few geothermal power plants (GeoPP) located on the Kamchatka Peninsula and on the Kuril Islands. At present three stations are online in Kamchatka: Pauzhetka GeoPP (11MWe installed capacity) and the two Severo-Mutnovka GeoPPs (12 and 50 MWe). Moreover, another GeoPP of 100 MVe is now being projected in the same place. Two small GeoPP are in operation on Kuril's Kunashir Isl., and Iturup Isl., with installed capacity of 2,6 MWe and 6 MWe, respectively.

3 Russia's place among other countries in geothermal energy use

Russia has considerable geothermal resources and the available capacity is far larger than the current application. This resource is far from adequately developed in the country. In the former Soviet Union, geological exploration was well supported for minerals and oil and gas. Such expansive activities were not aimed at discovering geothermal reservoirs even as a side issue; geothermal waters were not considered amongst useful energy resources. Still, the results of drilling thousands of "dry wells" (in oil industry parlance) brought a secondary benefit to geothermal research. These are the abandoned wells themselves, and the data on the subsurface geology, water-bearing horizons, temperature profiles, etc. collected during the exploration. Not all currently operating companies are willing to disclose their well data; in spite of the fact that it is cheaper to turn them over to others for new purposes than to stand under the cost of maintaining shut-in wells.

Figures 3 and 4 show the rate development in the use of geothermal resources in the world and in Russia (Lund et al., 2000). They illustrate particularly the rapid progress that is taking place in Russia.

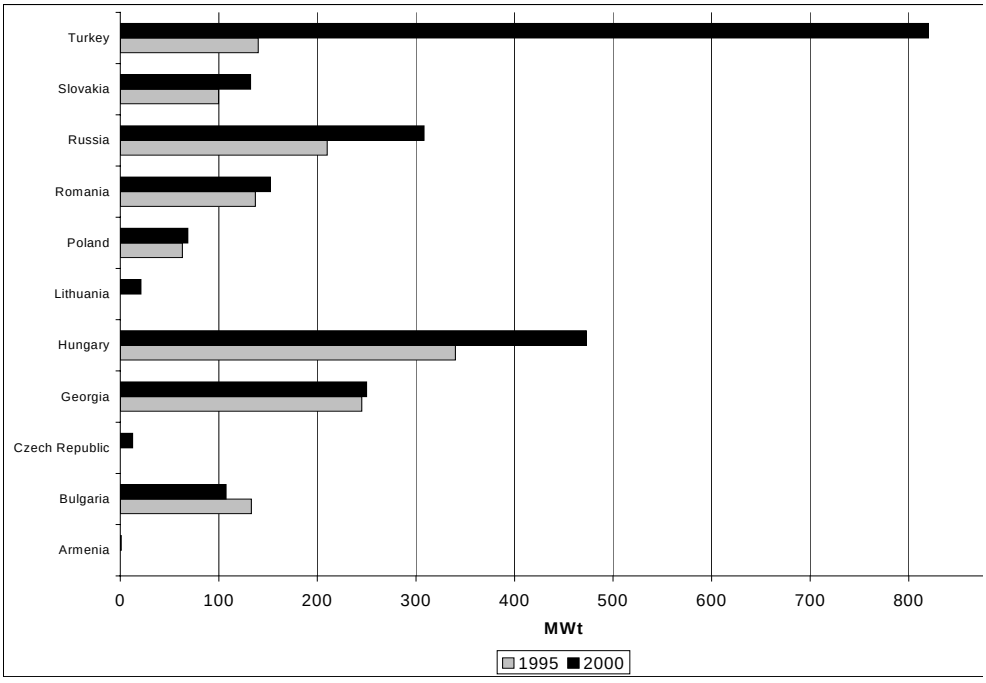


Figure 3: Geothermal energy capacity changes from 1995 to 2000.

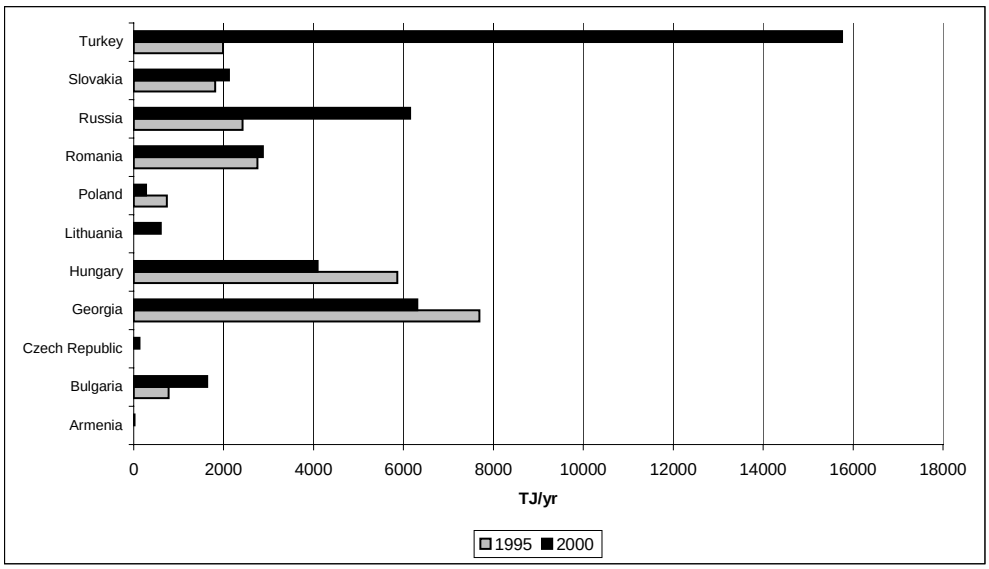


Figure 4: Geothermal energy utilization changes 1995-2000.

4 The concept of a nature-friendly energy support system for environmental park/aquapark

The choice of the optimal system of nature-friendly energy support is based on the use of the deep-thermal energy and other ecologically pure sources, depending on the actual conditions of the environmental park/aquapark, and takes into account all the environmental, economical and social factors. As a result the environmental passport of territories can be created.

The main directions of the required investigation are:

- Geological and geothermal assessments of the Park's territory, taking into account the possibility to use the deep thermal sources for energy supply.
- Hydrogeothermal and hydrogeochemical assessment of the territory (hot springs, thermal and mineral waters).
- Geographical assessment of the territory from the point of view of the possibility to use non-traditional renewable energy sources (solar, wind, tidal energy and energy of small rivers).
- Assessment of the possibility to use other specific energy sources of concrete region (waste utilization, biomasses, etc.).
- Creation of criteria for choice of system of energy supply (depending on conditions of the region).
- Planning of energy supply for a concrete region using both thermal sources (heat pumps) and other nature-friendly energy sources.
- Optimisation of the system of energy supply on the basis of environmental, social and economical factors.
- Choice of specific type of heat pump (types of design and thermal energy extraction) depending on concrete geological, environmental, economical, historical and social conditions of the Park's area.

5 References

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