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GEOTHERMAL POTENTIAL OF LITHUANIA AND OUTLOOK FOR ITS UTILIZATION

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ABSTRACT

The aim of this work is to present the geologic and tectonic situation in Lithuania's geothermal field, the potential of geothermal energy and efforts to utilize it. Lithuania is located in the centre of Europe within the following geographic coordinates: longitude 20°56'-26°51' E and latitude 53°54'-56°27' N. It borders Latvia on the North, Belarus on the East and South, Poland and Kaliningrad enclave (Russia) on the Southwest and the Baltic Sea on the West. Lithuania is a country with an area of 65300 square kilometres and population of 3.7 million. (1999).
The average air temperature ranges from -3 to -6°C in January, and from +16.5 to +17.5°C in July, and the annual mean varies from +5.1 to +8.5°C. Houses therefore should be heated from October to April. The annual primary energy consumption in Lithuania is 50.8 GJ per capita (1997). The aquifers defined in the sedimentary cover are potential sources for geothermal energy. They are conventionally grouped into several hydro-geothermal complexes. The geothermal resource density of Lithuania is ~ 7.3- 23.4x10^{10} J/m^2.
Assisted by the international community, construction of the Klaipeda Geothermal Demonstration Plant is approaching completion. This plant will make use of the Lower Devonian hydro-geothermal complex. Initial drilling has been done for the Vydmantai geothermal plant during its construction, and now there are efforts to continue this work. This plant would use the Cambrian hydro-geothermal horizon. These facilities will be centralized heating plants. At present, only a few small-scale geothermal pumps operate in some private houses.

1. INTRODUCTION

The interest in Lithuania's geothermal field began during oil prospecting in the western, most depressed part (to 2-2.2 km) of the Baltic syncline. More detailed studies began in cooperation with Russian and Belarussian scientists from the Lithuanian Institute of Geology. In 1992, the Baltic geothermal project was initiated and funded by Denmark, while Germany funded the Vilkaviskis spa geothermal project and other project studies.
Heat flow intensity in West Lithuania was found to be significantly higher (90-100 mW/m^2) than the background intensity (40-50 mW/m^2) of the region surrounding the geothermal field. From the geological point of view, such a phenomenon is rather rare in the old Precambrian Craton and can be explained only by extraordinary conditions at depth (i.e., thinned crust, occurrence of deep tectonic faults). This is confirmed by deep seismic sounding profiles performed recently that showed the depth to the mantle in West Lithuania is 40 km (background depth in the surrounding area is 44-55 km).
When evaluating geothermal conditions in the vertical section and taking into account the possibilities of using the energy for heating of buildings, the following horizons should be considered: crystalline basement rocks - so-called Hot Dry Rocks with temperatures exceeding 100^{o}C in West Lithuania; Cambrian hydro-geothermal complex with temperatures below 90^{o}C; Lower-Middle Devonian hydro-geothermal complex with temperatures below 45^{o}C; Middle-Upper Devonian hydro-geothermal complex with temperatures below 30^{o}C; upper hydro-geological stage with temperatures below 20^{o}C.
Based on the size of resources, the highest potential is thought to be in the crystalline basement rocks. Theoretically the electricity-producing plants could be built in these rocks, using heat from the depth of 4 – 5 km (Suveizdis et al., 1995). The Cambrian and Lower-Middle Devonian hydro-geothermal complexes, on the other hand, have received practical experimental use related to heating. The investigation of the Cambrian was completed at a depth of 1.9 km at temperatures of about 72^{o}C. The studies of the Lower-Middle Devonian complex indicated that the construction of a geothermal energy plant in Klaipeda city, using a circulation principle, could use the naturally produced temperature of 38^{o}C. Private initiatives also developed the use of low-temperature geothermal energy from the upper hydro-geological stage for heat pumps in private houses.

2. PRESENT SITUATION IN ENERGY SECTOR AND POLICY MEASURES FOR ITS DEVELOPMENT

Restoration of Independence in 1990 has brought Lithuania into the stage of overall economic change from a centralized economy to a market-oriented system. During the last several years, under the prevailing influence of economic restructuring, significant positive changes continue to take place in the economy and its main branch – the energy sector of the country. Thus, the annual increase of the gross domestic product (GDP) increased from 3.3% to 6.1% in 1995 – 1997, while relative energy consumption for GDP unit diminished.
The main document that defines energy policy goals and the directions of its development, the National Energy Strategy, was approved by the Government in 1994. Lithuania is dependent on imports of fuel from other countries, which is why the increase of indigenous primary energy consumption is so important (Fig.1), (Energy, 1997). Use of renewable resources is outlined in the National Energy Strategy as well as in the National Energy Efficiency Programme. This updated Programme, approved by the government in 1996, has been under way since 1992. Estimates show that within the next 15 – 20 years, 12 – 14% of currently imported energy resources can be replaced without any detriment to the country's environment by using as fuel wood, peat, domestic waste, biogas, water power resources, geothermal energy and other renewable energy sources. One of five key directions of the Programme, utilization of indigenous energy resources,

secondary and renewable energy sources (Table 1), (National, 1996), has thus been confirmed.
In a new version of the National Energy Strategy, which was approved by the Parliament in 1999, prognostic geothermal energy consumption of 753 TJ/year (or 18 ktoe/year) in 2020 was estimated. The decision to shut down the first unit of Ignalina nuclear power plant until 2005 is also noted in this Strategy (Table 2). The National Energy Strategy and National Energy Efficiency Programme were elaborated and are under implementation in cooperation with Western experts supported by the PHARE, TACIS, THERMIE, SYNERGY, INCO, USAID and bilateral programmes.
Activities in the energy sector have serious impact on the environment; therefore energy policy measures are closely linked with issues of environmental protection. In 1995, the Lithuanian Parliament ratified the UN Framework Convention on Climate Change (Rio UN FCCC, 1992). The National task force, with assistance of the UN FCCC Secretariat, developed the National Implementation Strategy for Rio UN FCCC, and the Government of Lithuania adopted the Strategy in 1996. This document estimates the current situation, presents forecasts of greenhouse gas emission in 2000 and 2010 and outlines the main measures to achieve the Rio UN FCCC target: to stabilize CO_2 emissions in 2000 at the level of 1990. This is also applicable to the Kyoto Protocol (1997), that establishes a legally binding obligation to reduce emissions of greenhouse gases to 8% below the 1990 level by 2008 – 2012.

3.GEOLOGIC - TECTONIC SITUATION

Lithuania is located on the Eurasian plateau on the western border of the East European Precambrian Craton. The geological section is made up of two structural stages: the lower stage, consisting of crystalline rocks of the Lower Proterozoic age, and the upper stage, consisting of sedimentary rocks ranging from Wendian to Quaternary age. The basement rocks are found at a depth of 200 – 2,300 m. The thickness of the sedimentary cover is nearly the same; the upper layer of the Quaternary sediments is from 30 to 240 m thick. The thickness of deposits of all Phanerozoic systems differs considerably in Lithuania, as does the interval of time of their formation. The most complete and thickest section of sedimentary rocks has been found in western Lithuania, while its southeastern part possesses the thinnest and most incomplete section.

4. GEOTHERMAL SITUATION

We shall start an evaluation of the variety in Lithuania's geothermal conditions according to geological and tectonic situations with the largest (anomalous) potential field in the western part. It contains the largest resources of geothermal energy. The temperature at the surface of the crystalline basement at a depth of 2-2.3 km ranges from 70-100^oC, and at depths of 3-5 km can reach 100-160^oC. The rocks of the crystalline basement, so-called Hot Dry Rocks, are composed of granites, gneisses and rarely volcanic formations. They are overlain by a 100-150 m thick hydro-geothermal complex of Cambrian sandstones, aleurolites and argillites with temperatures ranging from 60-90^oC. This complex occurs at the absolute depths of 1800-2100 m. It is overlain by an 800 m thick section of Silurian-Ordovician carbonaceous impermeable rocks that form a reliable aquitard. Further up, at 600-900 m absolute depths, lies the second hydro-geothermal complex of Lower-Middle Devonian, 300-400 m thick sandstone and aleurolite/aleurite stratified with argillite and clay deposits, where temperatures range from 30-40^oC. This complex is overlain by an 80-100 m thick carbonaceous Middle Devonian aquitard. Further upwards, at 400-600 m absolute depth, lies the regional Middle-Upper Devonian hydro-geothermal complex with temperatures of 20-30^oC. It is composed of terrigenous rocks of up to 200 m in thickness. At the very top of the sedimentary cover there are low-temperature waters contained in Quaternary rocks (morainic sand and gravel).
The second geothermal field embraces the following hydro-geothermal complexes: (1) Cambrian water-bearing sand beds, that are 60-100 m thick with temperatures of 20-60^oC and occur at 600-1500 m absolute depths; (2) Lower-Middle Devonian water-bearing sand-aleurite beds that are 100-300 m thick with temperatures of 20-30^oC and occur at 200-600 m absolute depths. The upper part of the sedimentary cover contains Middle-Upper Devonian sand-aleurite aquifers with temperatures lower than 20^oC, and Quaternary formations with several water-bearing intermorainic horizons expressed by sand-gravel strata. The third geothermal field is formed of Vendian-Cambrian, Lower-Middle and Middle-Upper Devonian beds described above. These beds and Mesozoic-Cainozoic aquifers lying above are carriers of low-temperature energy (Fig.2, Fig.3).
The geothermal energy resources are presented in Table 3. They are calculated for the zone of stable temperatures, i.e., from the "neutral layer" to the depth of 6 km (Suveizdis et al., 1995). In our opinion, inexhaustible sources of energy occur above the "neutral layer", i.e., in the zone of variable temperatures, since they are constantly replenished by Solar energy. In Lithuania, groundwater level and quality observations were also accompanied by water temperature measurements. These 11-14 year observations enabled us to highlight key regularities of temperature regime in the upper part of the subsurface hydrosphere (Groundwater, 1996).
The thickness of the variable temperature zone reaches 20-40 m through a conductive heat transfer process. As convection begins, the thickness of the zone increases to 40-70 m. Depending on hydro-geological conditions, the temperature in the variable zone is lowest in March-June, since there is a 2-5 month time lag of temperature in the beds compared to that in air. The highest temperatures (17.3^oC at the top and 7.4^oC at the bottom of beds) are observed in August-December, lagging 1-4 months behind the highest air temperatures. This should be taken into account when preparing projects for utilization of geothermal power in the variable zone.
Long-term observations have shown that in the variable temperature zone of Lithuania three fields have been identified that coincide with the geothermal fields distinguished. The first field is notable for temperatures higher by a degree than in the remaining areas. Infiltration of atmospheric precipitation via permeable formations causes the greater impact at depth of surface temperatures. The highest temperatures vary from 17.3 to 11.9^oC at a depth of 2.5 m,

and from 9.3 to 6.0°C at a depth of 30 m. The zone of stable annual temperatures begins below a depth of 40 m, where temperature starts increasing according to a geothermal gradient (3.5–5.0°C per 100 m).

The second field is characterized by significantly lower fluctuations in mean annual temperatures and temperature amplitudes. The fluctuation amplitudes rapidly decrease with depth, but they increase again in the aquifers due to groundwater flow. Heat transfer in this field proceeds by conduction and convection. Maximum temperatures vary from 14.2 to 11.1°C (at 2.5 m depth) and from 8.1 to 7.7°C (at 30 m depth). The zone of stable annual temperature begins at 60-70 m depth, where temperature starts increasing according to a geothermal gradient of 2.5-3.5°C/100 m.

The temperature regime in the third field is formed by conductive heat transfer and depends on the physical properties of rocks and water exchange processes. An influence of air temperature is observed as deep as 22.5 m. Maximum temperatures range from 11.7 to 9.9°C at 2.5 m depth and from 7.3 to 7.2°C at 30 m depth. Annual temperature amplitudes do not exceed 0.2°C at 22.5 m depth. This indicates that below 22.5 m a stable temperature zone begins with temperatures increasing according to a geothermal gradient of 1.5-2.5°C/100 m.

5. RESULTS OF INVESTIGATIONS AND GEOTHERMAL ENERGY PROSPECTS

Lithuania has no volcanic activity and no hot springs, but has many reservoirs with warm geothermal water which can be used for district heating, in health resorts and in swimming pools. Many different types of underground water have been found: drinking quality, mineral, mineralized and very mineralized (100-200 g/l) (Juodkazis et al., 1997).

The geothermal potential in Lithuania has been investigated through seismics, investigation of oil-and gas wells and the drilling of geothermal exploration wells. In parallel with the scientific research, drilling began on the first geothermal exploration well, Vydmantai-1, in 1989 and in 1993 the injection well, Vydmantai-2, was completed. The Cambrian aquifer was tested in both wells. Flow rate was up to 50 m^3/h at a temperature of 72°C. Although drilling was financed by the state, there was not enough money to finish the work on an experimental geothermal circulation plant and the wells consequently had to be shut in.

In accordance with the German company “Geothermie Neubrandenburg GmbH”, 2.3 million USD must be invested for the establishment of these plants with power 7.5 MW (2.0 MW – geothermal part). In the meantime, the Municipality of Kretinga and a local private company, “UAB Vydmantu siluma”, took great interest in these wells and are making efforts to find financing and start the plants operating (Table 4). The German experts from Geothermie Neubrandenburg and GFZ- Potsdam were interested in the Vydmantai project as an experiment in the exploitation of dual-permeable reservoirs (the porous-fissured type sandstone). These dual-permeable reservoirs are in contrast to normal porous ones characterized by alternations of porous rocks with high and low permeable units as well as by fractured intervals. The main objective of Vydmantai project is to install a geothermal direct use system in a dual-permeable reservoir setting.

In 1992 the Danish Environmental Protection Agency began financing the Baltic Geothermal Energy project. The decision to construct the Klaipeda Geothermal Demonstration Plant (KGDP) was based on the results of the Danish and Lithuanian studies, with additional economic calculations performed by Global Environmental Protection Fund and Danish Environmental Protection Agency through the mediation of the World Bank. The KGDP of 49.7 MW (20.9 MW, geothermal part) thermal capacity, is designed to extract 500-700 m^3/h of 38°C water from the Devonian aquifer (Table 5 and Table 6). The plant was built by UAB Geoterma (Vilnius) with assistance from Dansk Olie & Naturgas A/S, in co-operation with Houe & Olsen, PGI and Lithuanian experts. By now, 2 production and 2 injection wells have already been drilled (Table 7). KGDP is to be completed in the end of 1999. The financing package (in millions of USD) consists of: Grants, 6.90 from the Global Environmental Facility Trust Fund, 2.88 from the Danish Environmental Protection Agency, 1.04 from EU PHARE, 2.78 from the Government of Lithuania; Loans, 5.90 from the World Bank (IBRD) (Mahler, 1998).

The market economy has opened the way to private enterprise, with the result that geothermal heat pump systems have already been installed in Lithuania, the first in 1996 in Vilnius, and later in Klaipeda. The heat is extracted from shallow (30 - 60 m) aquifers or from the ground. Geothermal heat pump technology has offered new opportunities for geothermal energy, because Lithuania has an unlimited amount of low temperature (<20°C) geothermal resources, lying at relatively shallow depths. Its extraction is less complicated than for higher temperature, (from 60 to more than 80°C), deeper fluids.

Geothermie Neubrandenburg (Germany) has prepared the Vilkaviskis Balneological Geothermal Project. The plant in Vilkaviskis shall extract up to 6.1 MW from up to 150 m^3/h geothermal water at 49 °C and supply 41000 MWh/year to the district heating network of Vilkaviskis. Electrically driven compression heat pumps will be used. Total capacity of plant – 30.2 MW. A budget for the plant – 5.6 million USD.

Geothermal investigations have been carried out in 19 localities (Fig. 2). In 1999 professional personnel allocated to geothermal activities was from: Geology Institute, Lithuanian Energy Institute and Kaunas University of Technology – 5 persons; “Geoterma” UAB – 5 persons; “Vydmantu siluma” UAB, “Minijos nafta” UAB, “Alropa” UAB – 5 persons; Danish and German companies – 6 persons (Table 8). Investments in geothermal energy development are presented in Table 9. The main part of them, 19.5 million USD allocated to KGDP, is described above. In period from 1992 to 1999 Danish support was more than 4 million USD.

6. DISCUSSION

In Lithuania a situation favorable for geothermal energy utilization now exists. A commission was formed in the Seimas (Lithuanian Parliament) to deal with renewable energy sources and energy saving. The Lithuanian Energy Agency co-ordinates preparation of the National Sun Program to be concluded this year; the Program is to cover all the renewable resources, including the geothermal one. The legal basis for realization of the Program is expected to be created soon. Application of geothermal heat pump technologies both for centralized and individual customers is possible today. Primary investments, of course, are not small, since this type of equipment is expensive. Introduction of heat pumps could be promoted by a corresponding investment crediting system (Energy Efficiency Fund or Housing Credit Foundation); it could grant credits with minimum interest rates.

CONCLUSIONS

1. Geothermal resources are concentrated in Hot Dry Rocks and three hydro – geothermal complexes of the sedimentary cover: one Cambrian and two Devonian. The zone of variable temperatures (Quaternary rocks) is also available for heat extraction.
2. Devonian and Cambrian hydro–geothermal complexes will be investigated under working conditions: The Klaipeda Geothermal Demonstration Plant is being built under support of the international community; it will operate from the Lower Devonian hydro-geothermal complex with temperature of 38°C. The exploration geothermal wells Vydmantai-1 and 2 are drilled, and the Cambrian aquifer with a temperature of 72°C was tested.
3. The zone of variable temperatures has already been used for small-scale geothermal heat pump systems.
4. Utilization of geothermal energy on a large scale in Lithuania relies on geothermal heat pump systems.
5. Positive changes in energy sector (e.g., research, policy measures for development, decentralization of heating industry, with ownership transferred to Municipalities, privatization) create a good framework for geothermal energy adoption.

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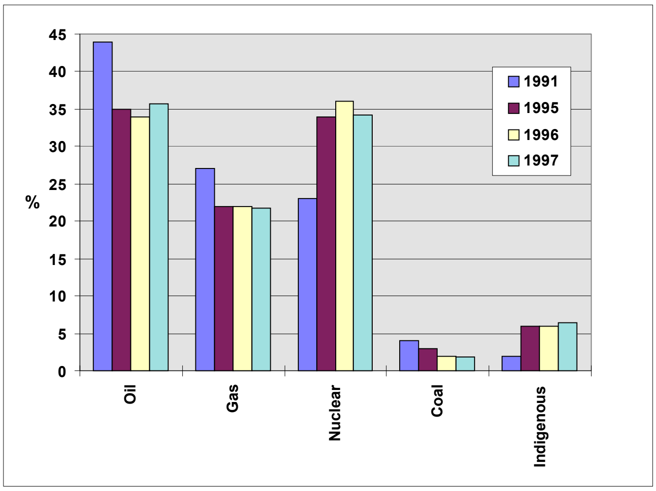


Figure 1. Breakdown of Primary Energy Consumption

Table 1. Possible energy production from indigenous and renewable resources

Resources		Possible energy production, TWh/year
Biomass		
Wood	PJ	4.0
Peat	PJ	2.7
Straw	PJ	1.5
Municipal waste	PJ	0.6
Biogas	PJ	1.6
Geothermal energy	TWh	0.8
Hydro	TWh	1.5
Solar	TWh	3.0
Wind	TWh	0.15
TOTAL	TWh	15.85

Table 2. Present and planned production of electricity

	Geothermal		Fossil Fuels		Hydro		Nuclear		Other Rewables(specify)		Total	
	Capacity MWe	Gross Prod. GWh/yr	Capaci-ty* MWe	Gross Prod.** GWh/yr	Capaci-ty* MWe	Gross Prod.** GWh/yr	Capaci-ty* MWe	Gross Prod.** GWh/yr	Capaci-ty* MWe	Gross Prod.** GWh/yr	Capaci-ty* MWe	Gross Prod.** GWh/yr
In operation in January 2000	-	-	2628	3180	909	900	3000	13550	-	-	6537	17630
Under construction in January 2000	-	-	-	-	-	-	-	-	-	-	-	-
Funds committed, but not yet under construction in January 2000	-	-	-	-	-	-	-	-	-	-	-	-
Total projected use by 2005	-	-	2628	4010	925	960	1500	8130	-	-	5037	13100

* - Installed Capacity, 1999.
** - Electricity Gross Production, 1998.

Table 3. Geothermal resources in Lithuania

Geothermal Field (fig.1)	Density of resources, J/m^2 x10^{10}	Area, km^2	Quantity of resources, Joules x10^{21}
I	23,4	6 500	1,5
II	15,4	36 000	5,5
III	7,3	22 8000	1,7
Total		65 300	8,7

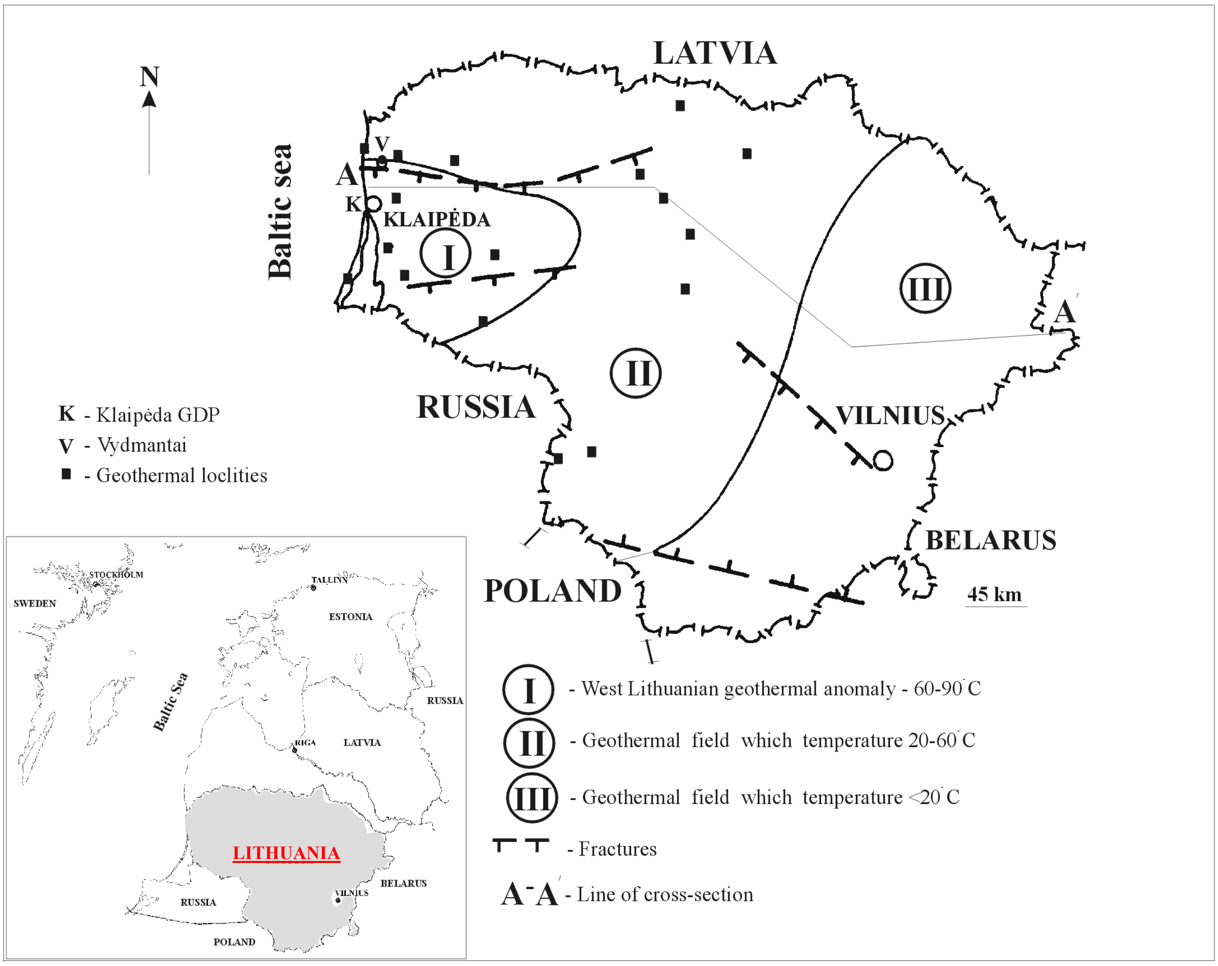
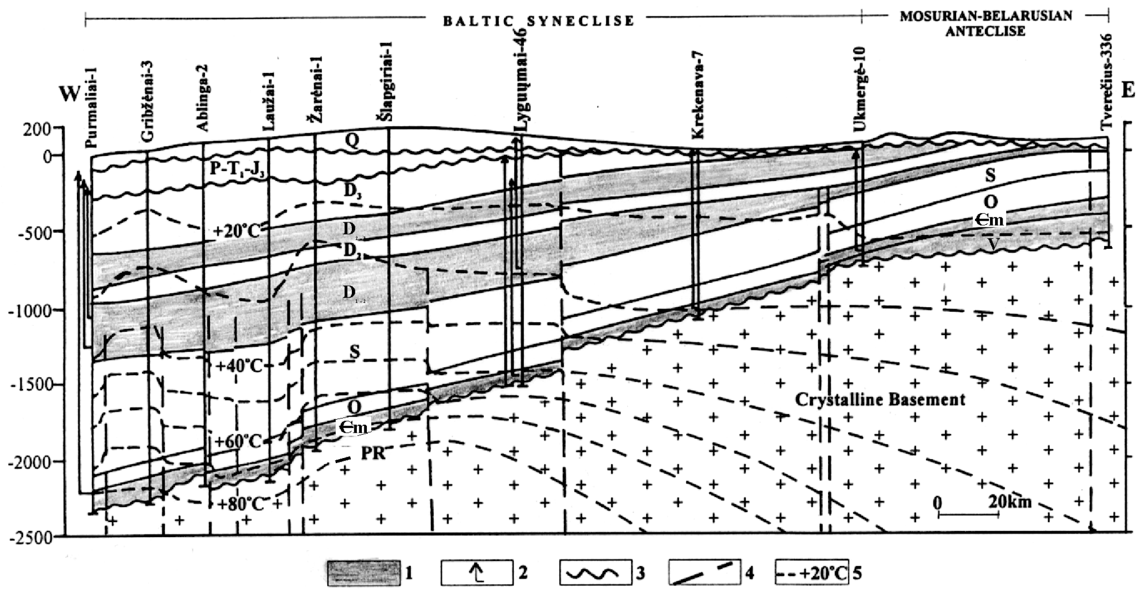


Figure 2. Division of Geothermal Field of Lithuania



1-hydro-geothermal complex, 2-hydrostatic head, 3-stratigraphic angular discordance, 4-fractures, 5-geoisotherm

Figure 3. Hydro-geothermal section through Lithuania. (For trace of section, see Figure 2)

Table 4. Utilization of geothermal energy for direct heat (projects; not in operation)

Locality	Type[1)]	Maximum utilization					Capacity[3)] (MWt)	Annual Utilization		
		FlowRate (kg/s)	Temperature (°C)		Enthalpy (kJ/kg)			Ave.Flow (kg/s)	Energy[4)] (TJ/yr)	Capacity Factor[5)]
			Inlet	Outlet	Inlet	Outlet				
Vydmantai	H,G	12.9	72	35	-	-	2	7.1	34.6	0.55
TOTAL							2		34.6	0.55

1) H = Space heating & district heating (other than heat pumps)
G = Greenhouse and soil heating
3) Capacity (MWt) = Max.flow rate (kg/s) [inlet temp. (°C) – outlet temp. (°C)] x 0.004184
4) Energy use (TJ/yr) = Ave. flow rate (kg/s) [inlet temp. (°C) – outlet temp. (°C)] x 0.1319
5) Capacity factor = [Annual energy use (TJ/yr) x 0.03171]/ Capacity (MWt).

Table 5. Geothermal (ground-source) heat pumps (on operation)

Locality	Ground of water temp. (°C)	Typical Heat Pump Rating or Capacity (kW)	Number of Units	Type[2)]	COP[3)]	Equivalent Full Load Hr/Year[4)]	Thermal Energy Used (TJ/yr= 10^{12}J/yr)[5)]
Klaipeda GDP*	38	5200	4	W	1.73	7945	598
Klaipeda"A"	8	12	1	W	3.3	3694	0.111
Klaipeda"B"	0	12	1	H	3.3	4148	0.125
Klaipeda"R"	8	43.1	4	W	4.2	1330	0.157
Vilnius"I"	12	15	1	W	3.3	4187	0.158
Vilnius"L"	8	15	1	W	3.3	3756	0.141
Vilnius"Y"	8	17	1	W	3.2	2034	0.086
TOTAL		114.1	9				0.778
TOTAL (prognostic)		5314.1	13				598.778

* - will be on operation in 2000.
2) Type of installation as follows: H = horizontal ground coupled
W = water source (well or lake water)
3) Report the COP = (output thermal energy/input energy of compressor) for your climate
4) Report the equivalent full load operating hours per year, or = capacity factor x 8760
5) Thermal energy (kJ/yr = flow rate in loop (L/s) x [(inlet temp. (°C) – outlet temp. (°C)] x 0.1319
or = rated output energy (kJ/hr) x [(COP – 1)/COP] x equivalent full load hours/yr

Table 6. Summary table of geothermal direct heat uses

Use	Installed Capacity[1)] (MW_t)	Annual Energy Use[2)] (TJ/yr=10^{12}J/yr)	Capacity Factor[3)]
Subtotal			
Geothermal Heat Pumps: - in operation - will be on operation in 2000	 0.114 20.9	 0.778 598	 0.215 0.907
TOTAL	21.014	598.778	

1) Installed Capacity (thermal power) (MW_t) = Max. flow rate (kg/s) x [inlet temp. (°C) – outlet temp. (°C)] x 0.004184
2) Annual Energy Use (TJ/yr) = Ave.flow rate (kg/s) x [inlet temp. (°C) – outlet temp. (°C)] x 0.1319
3) Capacity Factor = [Annual Energy Use (TJ/yr)/Capacity (MWt)] x 0.03171

Table 7. Wells drilled for direct use of geothermal resources

Purpose	Wellhead Temperature	Number of Wells Drilled				Total Depth (km)
		Electric Power	Direct Use	Combined	Other (specify)	
Exploration[1)] Vydmantai-1, Vydmantai-2 (1989-1993)	(all)	-	2	-	-	4.71
Production	>150°C	-	-	-	-	-
	150-100°C	-	-	-	-	-
	<100°C	-	2	-	-	2.5
Injection	(all)	-	2	-	-	2.5
Total		-	6	-	-	9.71

[1)] Include thermal gradient wells, but not ones less than 100 m deep

Tables 8. Allocation of professional personnel to geothermal activities
(Restricted to personnel with a University degrees)

Years	Professional Person-Years of Effort					
	(1)	(2)	(3)	(4)	(5)	(6)
1995	1	4	5	-	4	5
1996	1	4	5	-	4	5
1997	1	4	5	-	6	5
1998	1	4	5	-	6	5
1999	1	5	5	-	6	5
Total	5	21	25	-	26	25

(1) Government
(2) Public Utilities
(3) Universities – Institutes
(4) Paid Foreign Consultants
(5) Contributed Through Foreign Aid Programs
(6) Private Industry

Tables 9. Total investments in geothermal in (1999) USD

Period	Research & Development incl. Surface Explor. & Exploration Drilling Million USD	Field Development including Production Drilling & Surface Equipment Million USD	Utilization		Funding Type	
			Direct Million USD	Electrical Million USD	Private %	Public %
1985-1989	0.13 (million 90 RUS roubles)	-	-	-	-	100
1990-1994	2.03	-	-	-	-	100
1995-1999	0.035	8.51	15.4	-	0.4	99.6