IGEIA
Integration of Geothermal Energy into Industrial Applications

MARKET REPORT ON THE GEOTHERMAL APPLICATIONS POTENTIAL IN THE ESTONIAN INDUSTRY

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1. DEFINITION, CONCEPT

1.1. DEFINITION OF THE TERM 'INDUSTRY'

The adopted definition of *industry* corresponds to the standard classification which is called the International Standard Industrial Classification (ISIC)

A - Agriculture, forestry and fishing
B - Mining and quarrying
C - Manufacturing
D - Electricity, gas, steam and air conditioning supply
E - Water supply, sewerage, waste management and remediation activities
F - Construction
G - Wholesale and retail trade, repair of motor vehicles and motorcycles
H - Transportation and storage
I - Accommodation and Food service activities
J - Information and communication
K - Financial and insurance activities
L - Real estate activities
M - Professional, scientific and technical activities
N - Administrative and support service activities
O - Public administration and defence, compulsory social security
P - Education
Q - Human health and social work activities
R - Arts, entertainment and recreation
S - Other service activities
T - Activities of households as employers, undifferentiated goods and services producing activities of households for own use
U - Activities of extraterritorial organizations and bodies

1.2. ENERGY CONSUMPTION IN ESTONIA

Rapid development of Estonian economy in last years has brought along some growth of **primary energy consumption**, but no tendency of steady increase can be observed (see Table 1).

Table 1. Primary energy supply, PJ

	2000	2001	2002	2003	2004	2005
Oil shale	120.5	118.1	116.1	136.4	136.5	131.1
Fuel peat	2.2	2.2	2.4	2.3	2.0	1.8
Wood fuels	20.7	21.8	21.8	24.1	25.1	24.4
Coal and coke	1.7	2.3	0.8	0.4	0.6	0.5
Fuel oils	1.7	1.9	9.0	4.5	-1.6	-3.7
Motor fuels	18.3	25.6	20.8	23.9	31.4	33.5
Natural gas and LPG	28.1	30.2	25.2	27.8	32.7	33.8
Electricity	-3.3	-2.2	-2.5	-6.8	-6.3	-5.5
Other	1.0	0.7	0.1	1.8	0.1	0.2
Primary energy supply	190.9	200.6	193.8	214.4	220.4	216.1

The structure and development of primary energy supply is shown in Figure 1. It has to be noted that the self-sufficiency of Estonia's energy supply is rather high – approximately 65 – 68%.

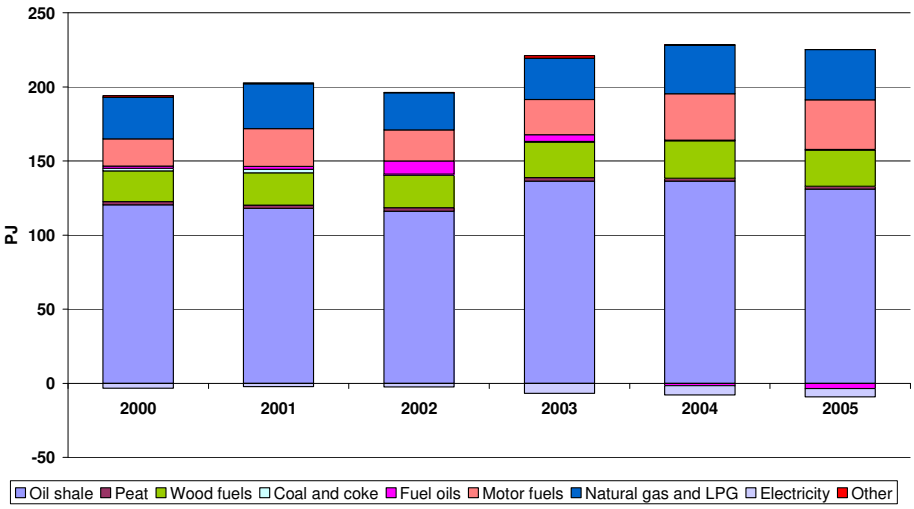

Figure 1. Structure of primary energy supply in 2000 – 2005

Both the primary and final energy use have increased. Nevertheless, the positive tendency is that the growth of final use has been faster (+27.8%; 5.0% per year) than that of primary energy use (+23.3%; 2.5% a year). In 2002 and 2005, there was even a decline in primary energy use: by –3.4% and by –2.0% correspondingly (see Figure 2). The increase in energy consumption is obviously the result of fast development of economy and improving living conditions of households.

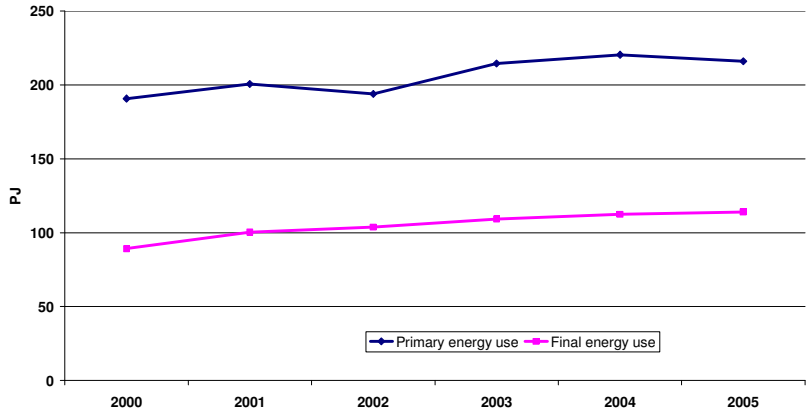

Figure 2. Dynamics of primary and final energy use in 2000 – 2005

Regarding **fuel consumption for conversion of fuels**, in 2005 80.7% (174.4 PJ) of total primary energy supply (216.1 PJ) was utilized in conversion processes, more than the half of it was used for electricity generation (see Figure 3).

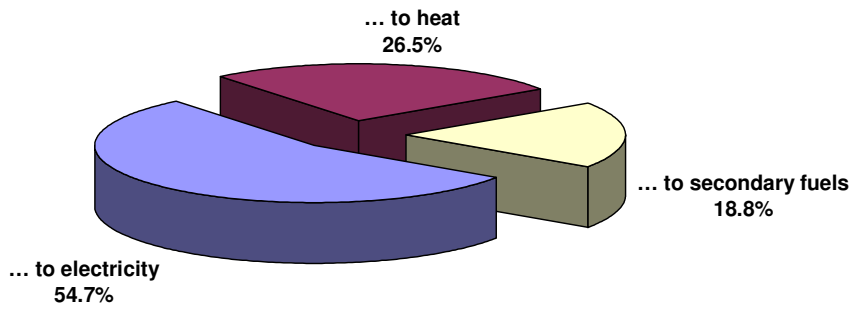

Figure 3. Shares of fuel consumption for energy conversion in 2005

In Estonia the electricity consumption is based mainly on firing of oil shale, which is an indigenous solid low grade fuel. In 2005 oil shale accounted for 94.3% of fuels used for electricity generation.

As to heat production, the largest share of heat has been produced from natural gas, but the share of wood fuels (wood chips, logs, pellets and waste) is large as well (Figure 4).

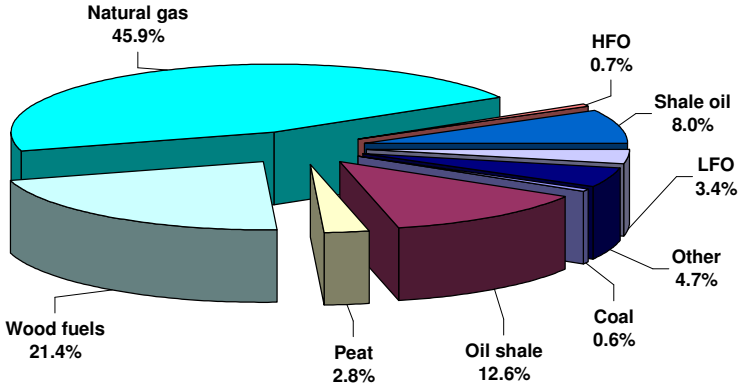

Figure 4. Structure of heat production by fuel type, 2005

The structure of **final use of fuels and energy** in 2005 by energy type is shown in Figure 5.

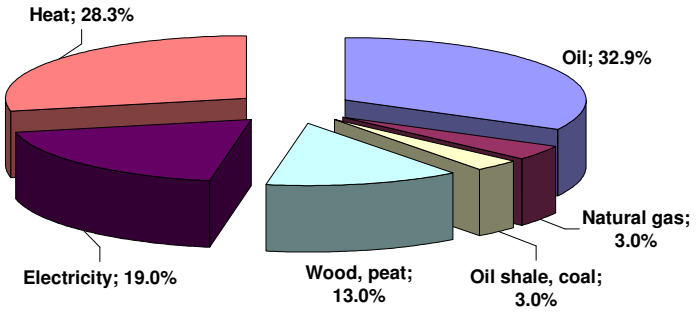

Figure 5. Structure of final energy use by fuel and energy in 2005

2. LEGAL AND TECHNICAL CONDITIONS FOR GEOTHERMAL APPLICATIONS

The decisions on environment related policies and measures can be taken at national and at local level. In Estonia the Parliament – Riigikogu – is the highest legislative body. The Government of the Republic of Estonia is the supreme executive authority and the Ministry of Environment – the highest executive body responsible for carrying out national environmental policy. As a rule, environmental legislation is initiated by the Government or by the Ministry of Environment (MoE). In some aspects, the initiative can come from the Ministry of Economic Affairs and Communications (MoEAC) or from the Ministry of Agriculture (MoA). The MoEAC is responsible for energy related issues, including energy efficiency and conservation, also for the use of renewable sources in the energy sector. Some responsibilities of the Ministry of Finance include matters important for environment and energy management – taxation, use of state budget funds, etc.

2.1. LEGAL ACTS[1]

The *Sustainable Development Act* prescribes the most general principles of sustainable development, thus serving as a basis for all environment related legislation and relevant national programmes. Therefore, the legal acts regulating the energy sector usually take into account major environmental issues.

The *Planning Act* regulates relations between the state, local governments and other persons in the preparation of plans. The purpose of the Act is to ensure conditions for balanced and sustainable spatial development, spatial planning, land use and building.

The *Building Act* provides the requirements for construction works, building materials, construction products, building design documentation and as-built drawings of construction works, and the basis and procedure for the design, building and use of construction works and for the registration of construction works, and the organisation of state supervision and construction supervision.

The *Environmental Impact Assessment and Environmental Management System Act* entered into force in April 2005. The Act provides legal bases and procedure for assessment of likely environmental impact, organisation of eco-management and audit scheme and legal bases for awarding eco-label in order to prevent environmental damage and establishes liability upon violation of the requirements of this Act. The Act specifies the procedure and principles of environmental impact assessment; especially the strategic assessment is regulated in detail. The Act makes strategic environmental assessment mandatory in the case of national, county and local plans and programmes. Regarding mandatory environmental impact assessment the Act stipulates (§ 3):

> *Environmental impact shall be assessed:*
>
> > *1) upon application for or application for amendment of a development consent if the proposed activity which is the basis for application for or amendment of the development consent potentially results in significant environmental impact;*
> >
> > *2) if activities are proposed which alone or in conjunction with other activities may potentially significantly affect a Natura 2000 site.*

The environmental impact is defined (§4) as any potential direct or indirect effect of activities on human health and well-being, the environment, cultural heritage or property. The environmental impact is defined (§5) as significant if it may potentially exceed the environmental capacity of a site, cause irreversible changes to the environment, endanger human health and well-being, the environment, cultural heritage or property. The list of activities with significant environmental impact (§6) includes:

> *18) groundwater abstraction exceeding 200 000 cubic metres of water per year.*

[1] All translations of excerpts from legal acts are unofficial ones

As an act of secondary legislation the Government the Republic has issued a Regulation No. 224 of 29 August 2005 *Detailed list of areas of activity requiring consideration of need for initiation of environmental impact assessment,* where there are following (among many others) activities listed:

(§ 3 Extractive industry and geology)

1) general geological investigation/survey;
2) geological exploration;
3) deep drillings (boreholes with depth over 1000 metres).

(§ 11. Special use of water)

8) groundwater abstraction where the annual volume of water abstracted is 50 000 – 200 000 cubic metres.

The *Environmental Supervision Act* (RT I 2001, 56, 337) entered into force in July 2001. The Act defines the nature of environmental supervision and establishes the rights and obligations of persons and agencies who exercise environmental supervision, the rights and obligations of persons and agencies which are subject to environmental supervision, and the procedure for supervisory operations.

The *Earth's Crust Act* entered into force in 2005. The Act provides for the procedure for and the principles of exploration, protection and use of the earth's crust, with the purpose of ensuring economically efficient and environmentally sound use of the earth's crust. In the Act the earth's crust is defined (§ 2) as the upper layer of the ground accessible for human activity on land, in transboundary water bodies, on the territorial sea, in inland maritime waters and in the exclusive economic zone. The Act regulates (§ 1):

1) *geological investigation;*
2) *geological explorations;*
3) *extraction of mineral resources, except in the part regulated by the Mining Act*
4) *the rights of the owner of an immovable upon use of mineral resources within the boundaries of the owner's immovable;*
5) *restoration of the land disturbed by geological investigation, geological explorations or mining;*
6) *use of the earth's crust not related to the extraction of mineral resources, except in the part regulated by the Mining Act and the Water Act.*

As stipulated in the Earth's Crust Act (see above) the (ground) water related issues are regulated by the *Water Act* (in force since 1994). The purpose of the Act is to guarantee the purity of inland and transboundary water bodies and groundwater, and ecological balance in water bodies. The Act regulates the use and protection of water, and relations between landowners and water users. Regarding the organisation of water use the Act provides (§ 3) that the use and protection of water at state level shall be organised by the Government of the Republic. Within its administrative jurisdiction, a local government has the authority to:

- grant permission for special use of water;
- organise administration of the water bodies belonging to the local government;
- organise elimination of the consequences of water accidents and sudden water pollution;
- establish temporary restrictions concerning public water bodies pursuant to subsection 7 (4) of this Act.

Regarding the use of water and water bodies the Act stipulates (§ 6) that the use of water and water bodies is either public or special. Public use of a water bodies is the use of a water body by anyone without any constructions or technical equipment which could affect the condition of the water body (in accordance with § 7 of the Act). Special use of water is the use of water with technical equipment, constructions or substances which could affect the condition of a water body or aquifer (in accordance with § 8 of this Act). The Act stipulates (§ 8) that for the special use of water, a user shall hold a permit with a specified term and, in the case of using the land of another, also the permission of the landowner. A permit for the special use of water is necessary if:

- water is abstracted from a surface water body, including if ice is abstracted in a volume of more than 30 m^3 per day;
- is abstracted more than 5 m^3 of groundwater is abstracted per one twenty-four hour period;
- mineral water is abstracted;
- effluent or other water pollutants are discharged to a recipient;
- a water body is barred or dammed or the water level thereof is lowered, or hydro-electric energy is used;
- a water body is dredged or soil is disposed of on the bottom of the water body;
- solid substances are sunk into a water body;
- groundwater is amended, lowered or redirected;
- the physical or chemical characteristics of water or the biological characteristics of a water body change upon water use.

Regarding secondary legislation related to water the following acts of the Minister of Environment should be noted:

- *Procedure for issue and revocation of special water use permits.* Regulation No 63 of the Minister of Environment of 24 December 1996;
- *Ground water survey, usage and protection.* Regulation No. 8 of the Minister of the Environment of 30 January 1997.

3. POTENTIAL IN ESTONIA / CLIMATIC REGIONS

Estonia is a small country, its area (45 227 km²) is similar to that of the Netherlands yet the population is much smaller – 1.34 million (as of 1 January 2007). The percentage of uninhabited areas in Estonia is relatively large and therefore the population density low – 30 inhabitants per km². Estonia's neighbours are Russia in the East, Latvia in the South, over Baltic Sea Sweden in the West and Finland in the North. The administrative division includes 15 counties, 227 administrative units with local governments, of which 33 cities, 194 rural municipalities and 14 cities without municipal status (see Figure 6).

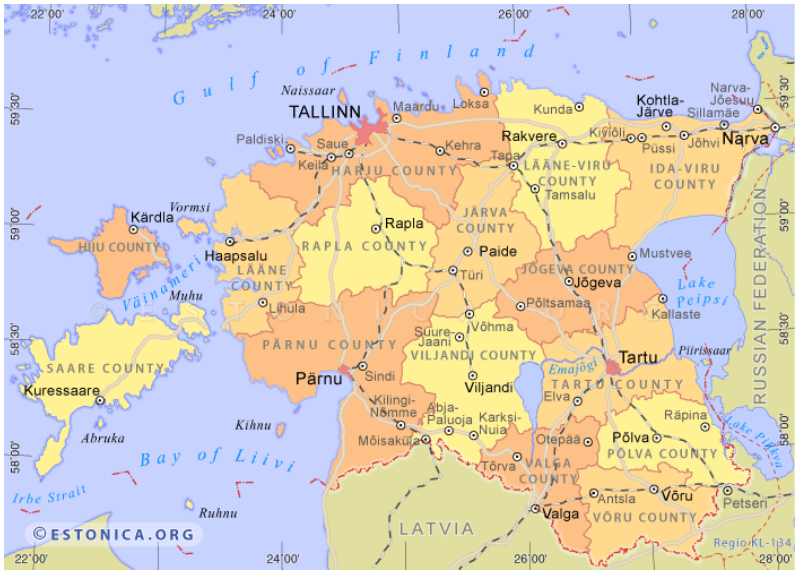

Figure 6. Administrative division of Estonia (counties and major cities)

Estonia is located in the northwestern part of the East-European Plain, i.e. within a transition zone from maritime to continental **climate**. The main factor influencing the climate of Estonia is the Atlantic Ocean (in particular the North-Atlantic Stream), which influences the climate in the whole of Europe. The active cyclonic activity occurring in the northern part of the Atlantic Ocean (the Icelandic minimum) determines a very high variability of the weather in Estonia and causes strong winds, high precipitation and abrupt fluctuations in temperature.

The main factor of differences in air temperatures between regions in Estonia is the Baltic Sea. In winter it keeps the coastal areas much warmer than the inland. At this time, the isotherms run from the north down to the south, during this period it is warmer in the west and colder in the east. The average air temperature in January is –6° to –7°C in Central and East Estonia and –2° to –4°C in the West-Estonian Archipelago. The coldest month is February.

The annual average temperature in Estonia is between 4.3°C and 6.5°C, being lower on the uplands and higher on the western coast of the islands. The vegetation period lasts for 180–195 days and the frost-free period 110–190 days. Both are longer on the coast. In spring the inland warms up much faster than the sea. Therefore, coastal areas remain comparatively cooler than the rest of Estonia. Differences between the average temperatures in May exceed 3.5°C. In summer these territorial differences begin to disappear. The average temperature in July varies between 16.0°C and 17.4°C. In autumn, again, the inland cools down much faster than the coastal areas. Towards the winter, the contrasts in air temperatures become increasingly distinct.

Estonia is located in a region of humid climate, where the amount of precipitation exceeds the total evaporation. The annual average of the relative air humidity is 80–83%. It is higher in winter and at its lowest in May, being 70% on average. The annual average precipitation varies between 550 and 800 mm. As a rule, the coastal zone receives less rainfall than the inland areas. It is particularly dry on the coast in spring and in the first half of summer. Areas with the highest

precipitation are located on the uplands and at a distance of 30–60 km from the western coast. The latter zone receives a comparatively large amount of precipitation in autumn and early winter.

The snow cover in Estonia is characterised by large territorial and temporal variations. The average duration of snow cover during winter is 75–135 days. Snow cover remains for the shortest time on the small islands near the western coast of Saaremaa Island and for the longest time on the Haanja and Pandivere Uplands.

Regarding **topography**, Estonia's territory, as a part of the East European Plain, is flat with uplands and plateau-like areas alternating with lowlands, depressions and valleys (see Figure 7). The bases of the uplands of Estonia are usually 75–100 m above sea level (a.s.l.). The highest point in Estonia and the Baltic States, Suur Munamägi (318 m a.s.l.), is located in South-East Estonia.

Figure 7. Topographic overview of Estonia's territory

Depressions and valleys are large features of relief, easily distinguished in South Estonia, where they separate the uplands. In most of the Estonian territory, the Palaeozoic sedimentary rocks are covered by Quaternary sediments. Most of the Palaeozoic bedrock outcrops occur in coastal cliffs near the sea and the larger lakes and in river valleys. All these outcrops have been formed by the erosive power of lakes, seas or rivers during the Pleistocene glaciation.

The present-day topography is largely a reflection of the bedrock geology. The deepening of the sea floor of the Gulf of Finland from Finland towards Estonia corresponds to the deepening of the crystalline basement. The rise of the sea floor towards the North Estonian limestone plateau corresponds to the erosional boundary of the Palaeozoic rocks under the sea. Another valley, in Central Estonia, oriented in the East-West direction, corresponds to the contact of hard Silurian limestones and soft Devonian sandstones.

Mires have also contributed to the flattening of the surface topography. The oldest mire deposits in Estonia are about 8000 years old. The most intense peat formation in bogs has taken place during the past 2000 years. The mire lowlands cover more than 1/5 of the Estonian territory.

As to **hydrography**, the climate conditions and relief of the region have caused formation of numerous small inland water bodies in the territory of Estonia. Annual precipitation here exceeds evapotranspiration and the excess water (200–300 mm/year) runs off via rivers. The territory is divided into four basins: the drainage basin of Lake Peipsi (38%), the drainage basin of the Gulf of Finland (excl. the Narva River; 21%), the Gulf of Riga (32%) and the islands of West-Estonia (9%).

There are many rivers in Estonia, the majority of which are short and have a relatively small runoff. Only ten rivers are longer than 100 km. In the territory of Estonia there are about 1200 natural lakes whose water area exceeds 1 ha. Lakes cover 4.7% of the territory of Estonia and are unevenly distributed over the territory. Creation of artificial water bodies, mainly to ensure operation of water mills, has been relatively common in Estonia throughout the centuries. To date, approximately 150 such artificial lakes have been preserved. In order to diversify landscapes and create swimming possibilities, new artificial lakes have been constructed in the vicinity of large settlements.

4. SECTORS SELECTION

4.1. OVERALL ECONOMIC BACKGROUND AND OVERVIEW OF MANUFACTURING

Estonia is experiencing a rapid growth of economy: during 1993 – 2005 the annual average rate of economic growth (at constant prices) has been 5.7%, what has resulted in total increase of the gross domestic product (GDP) by 94.2%. The pace of economic growth has increased since 2000, being between 7.1% and 10.8% on annual basis[2].

Regarding industry, in 2005 there were approximately 5,000 enterprises in Estonia whose principal field of activity was manufacturing industry. The dynamics of value added shares of branches in manufacturing is presented in Figure 8.

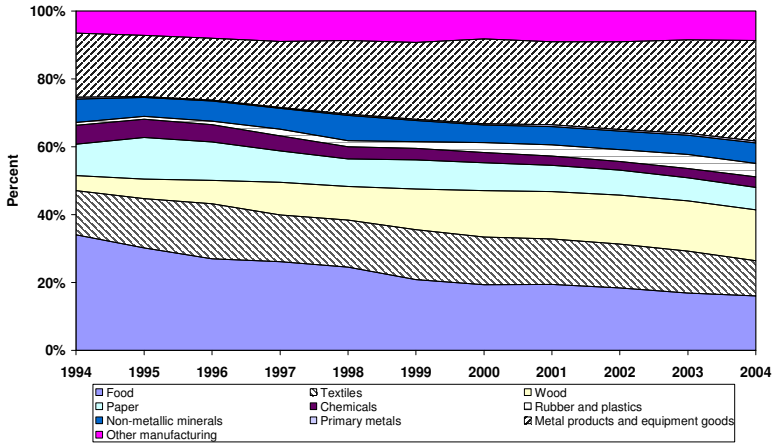

Figure 8. Structure of value added in manufacturing industry

The **food industry** is the largest branch in industry of Estonia. During the last decade, the output of food industry has tripled. Nevertheless, due to the increased efficiency the number of employed in this sector has dropped to 16,700 people. Food industry output continued to grow in 2005, mainly on account of the growth of domestic consumption. The development was the fastest in meat industry and production of beverages.

Food industry enterprises are geographically located quite evenly over Estonia. Among the large companies in all regions of Estonia there are also food producers. Meat processing enterprises AS Rakvere Lihakombinaat in Lääne-Viru County and AS Tallegg in Harju County are by far the largest in food industry. Meat processing companies AS Saaremaa Liha- ja Piimatööstus (Saare County) and AS Valga Lihatööstus (Valga County) are much smaller. AS Leibur (Tallinn and Tartu)is the largest bakery among approximately two hundred ones. The major food industry enterprises also comprise the breweries AS Saku Õlletehas in Harju County and AS Tartu Õlletehas (City of Tartu), and dairy firms Tallinna Piimatööstuse AS (Tallinn) and AS Põlva Piim (Põlva). AS Maseko operating in Harju and Pärnu Counties is the largest fish processing company.

The **wood industry** is one of the largest industries in Estonia. Among biggest branches, wood industry has developed the most – Estonia is well supplied with its own raw material and processing of imported raw material is also growing.About 1000 enterprises are engaged in wood processing and manufacture of wood products, the total employment in the sector being about 17,000 people. In 2000-2005 the output volumes grew by almost twice and the share of exports in total sales has risen to 66%. The Estonian wood industry is closely related to the Scandinavian wood sector through ownership relations. Due to the continuously dropping felling volumes in Estonian forests since 2000, the competition for timber has become fierce: small businesses find it especially hard to get raw materials. At the same time the share of imported raw materials has grown, primarily from Russia.

2 According to preliminary calculations, in 2006 the Estonia's GDP increased by 11.4% at constant prices if compared to the previous year.

The assortment of the wood industry's products is comprehensive, ranging from sawn timber production and processing to manufacture of log homes, windows and doors. The wood industry is evenly spread all over (mainland) Estonia. The largest wood industry enterprises are located in Pärnu, Järva, Harju, Tartu and Viljandi Counties, employing one tenth or even more of the industry's workforce. The largest number of employees are employed by the veneer factory AS Balti Spoon (Harju County), veneer products manufacturer AS Technomar & Adrem (Harju County) and laminboard factory AS Repo Vabrikud (Ida-Viru County). The largest veneer manufacturer is UPM Kymmene Otepää (Valga County). The largest sawmills by output are AS Imavere Saeveski (Järva County) and AS Paikuse Saeveski (Pärnu County – both belong to the Scandinavian wood and paper company Stora Enso) and AS Toftan (Võru County).

In Estonia, more than 400 enterprises are active in **furniture manufacturing**. In the years 2000-2005, production volumes at constant prices have grown by more than a half; more than 70% of the output is exported. Output has grown thanks to the exports but in recent years the domestic demand has grown as well. AS Tarmeko (Tartu) is by far the industry's largest company. The other larger furniture manufacturers are Flexa Eesti AS (Lääne Viru County), Valga GOMAB Mööbel AS (Valga) and AS Standard (Tallinn City), AS Jalax (Tallinn City) is the largest manufacturer of metal furniture.

The **paper industry** is an industry with long traditions, established in Estonia already in the 17th century. Currently there are about 50 paper, pulp or paper products enterprises in Estonia. In the years 2000-2005 the output of the paper industry grew by a third; more than 70% of the output is exported. Sales have grown due to increased exports but the demand in the domestic market for paper products is also growing. In Estonia the paper industry is heavily concentrated – the two larger companies employ more than half of the workforce and give over half of the total turnover. Horizon Tselluloosi ja Paberi AS (Kehra, Harju County) is the main pulp and paper company in Estonia. Smead Eesti AS in Kohila (Harju County) is the largest manufacturer of paper products. Räpina Paberivabrik (Põlva County) is a smaller manufacturer producing paper and cardboard from waste paper. Most of the companies make paper products from imported paper. In 2006, Estonian Cell – a new aspen pulp plant in Kunda (Lääne-Viru County) was launched. The plant is designed for an annual capacity of 140 000 tons of aspen pulp. The pulp is raw material for high quality paper and tissue.

Estonian **textile industry** is focused on export markets. The industry has increased its sales four-fold over the past ten years. The share of exports in the sales has also increased, amounting to 85% in 2005. The number of employees in this branch has grown by a tenth in the last five years and is now almost 11,000 people. The largest textile companies are not concentrated in only one region. The major companies making home textiles AS Wendre and AS Toom Tekstiil are located in Pärnu and Viljandi counties, technical textile producers OÜ Pärnu Linavabrik and AS Mistra-Autex are located in Pärnu and Harju counties, Kreenholmi Valduse AS and some others are in Ida-Viru county (in City of Narva).

The Estonian **chemical industry** has been tightly linked to the oil shale industry. However, other chemical industry branches are also developing more and more. Due to the reconstruction of production, the employment has continuously dropped in this sector. More than half of the Estonian chemical industry is located in Ida-Viru County, one third of the workforce is in Tallinn and Harju County. The largest chemical industry companies are Viru Õlitööstus AS (affiliate of Viru Keemia Grupp) (shale oils), Viru Liimid AS (adhesive resins), Kiviõli Keemiatööstuse OÜ (shale oils), AS Silmet (rare metals), Velsicol Eesti AS (benzoic acid, sodium benzoate), Orica Eesti OÜ (explosives), AS Nitrofert (mineral fertilisers, ammonia and carbamide) – all located in Ida-Viru County. ES Sadolin (Rapla County) and AS Tikkurila-Vivacolor (Tallinn) are largest paints manufacturers, Henkel Makroflex AS (Tallinn) and OÜ Krimelte (both located in Tallinn) produce assembly foams. Largest pharmaceutic companies are AS Nycomed Sefa (Põlva County) and Tallinna Farmaatsiatehase AS (Tallinn).

The **rubber and plastic industry** has developed vigorously in recent years. Sales in the domestic market have gone up but most of the sales growth is due to the expanded exports which have grown by several times, new enterprises have emerged in the sector. The largest enterprises in the rubber and plastic industry are Nolato Tallinn Polymer AS (components of mobile phones), AS Glaskek (plastic windows),

AS Estiko-Plastar (film and plastic bags), Pipelife Eesti AS (plastic pipes), AS Polyform (videotape cases, packages for food industry), OÜ Jumboplast and Greiner Packaging AS (plastic packages), OÜ Jumbostrap (large bags), AS Baltplast (wall-covering materials, polyethylene grassmats) and AS Balteco (baths). The largest enterprises are located in Tallinn and Harju County (almost half of the workforce), Ida- Viru and Tartu Counties (more than one-tenth of the workforce), and Hiiu and Saare Counties also employ quite a lot of labour. It is expected that positive developments in the rubber and plastic industry will continue in the next years.

The **metal industry** has developed extremely fast during the re-independence period. Output of the industry has grown tenfold in ten years, thanks to exports but also the increased domestic demand (in machinery and equipment and construction sectors). The industry employs more than 10,000 people, being one of the largest sectors in this respect. The metal industry is concentrated in Tallinn and its vicinity (more than half of the workforce) and Ida-Viru County (almost a quarter of the workforce). The largest enterprises are engaged in manufacturing of metal structures (AS Kohimo, AS Viljandi Metall), building structures (AS Rannila Profiil, AS Saku Metall), manufacture of products for power plants and servicing power plants (Alstom Estonia AS, AS Energoremont), metalworking (AS Balti ES, AS Tarkon) and metal galvanisation (Galvex Estonia OÜ). Tha largest manufacturer of metal is AS Demidov Industries (aluminium alloys). The sector has positive outlooks for the next years. Both domestic demand and exports are on the growing trend according to forecasts.

The output of the **machine engineering sector** has continuously grown in recent years. The largest companies are AS Hekotek (wood processing equipment), AS Tallinna Masinatehas (Tallinn Machine Building Plant) (industrial air coolers), AS Mäetehnika (buckets, equipment for tractors), AS Fors MW (timber trailers, log lifts), and AS Finmec (parts of lifts). However, smaller enterprises are dominating in the sector. The enterprises are distributed quite evenly across Estonia; the largest ones are concentrated around the largest cities, Tallinn and Tartu, and in the Ida-Viru County industrial region.

The **manufacture of transport equipment** depends mainly on the sales to foreign markets. Exports make two thirds of the sales in this sector. The increased export and domestic market sales have expanded the output. The largest enterprises are AS Norma (safety belts), Loksa Laevatehase AS (ship building); affiliates of Balti Laevaremonditehas (ship repairing) – OÜ Tallinna Laevatehas, OÜ BLRT Rekato, OÜ Tehnomet and AS Baltic Premator; OÜ Tarmetec (car accessories), AS Ühinenud Depood (repair of railway rolling stock), Universal Industries OÜ (dampers). The largest companies are concentrated in Tallinn and Harju County, but are also located in Tartu, Ida-Viru and Saare Counties.

4.2. ENERGY CONSUMPTION BY SECTORS

The analysis of final energy consumption by sector indicates that households account for one third of final energy use, the second being transport with 28% and third the industry (incl. construction) with 22.7% (see Figure 9).

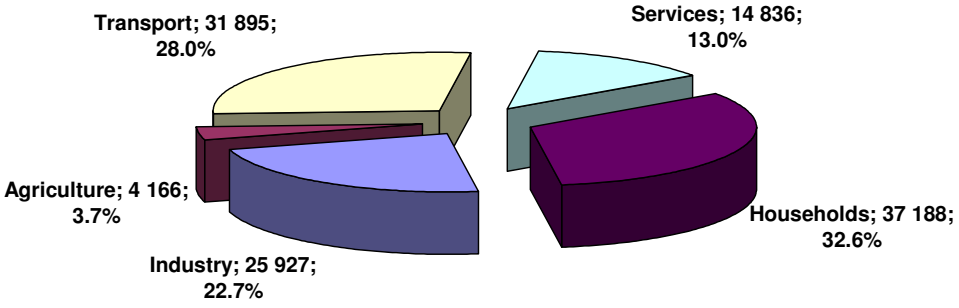

Figure 9. Final energy use by sector in 2005 (TJ)

In manufacturing industry (construction not included) the largest energy use is in wood and wood products sector, which is also the biggest (in manufacturing) consumer of electricity (1291 TJ) and heat (2387 TJ). In manufacturing the largest share (48.8%; 3537 TJ) of fuels is used for producing other non-metallic products (mainly building materials).

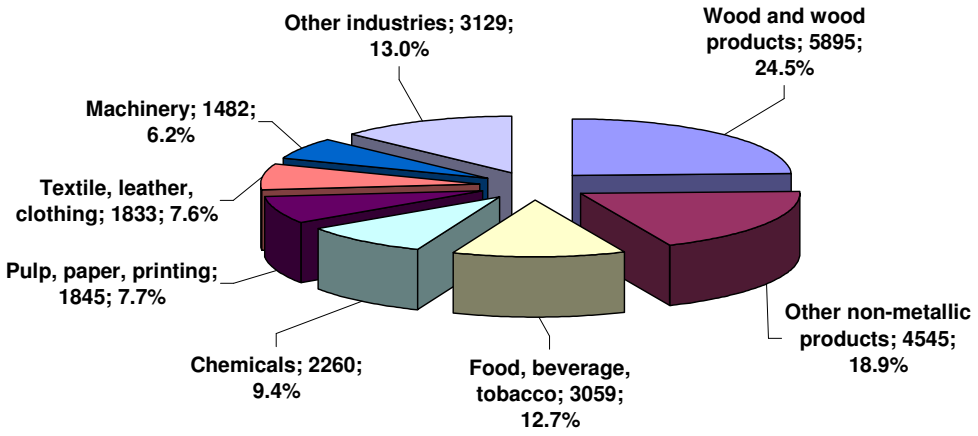

Figure 10. Energy use in branches of manufacturing industry in 2005 (TJ)

4.3. CURRENT SITUATION ON HP MARKET

Quite a number of HP units have been installed in Estonia during last 5-6 years and this process is accelerating. HP installations have proved reliable and economically reasonable solutions in cases, when electrical capacity was available and alternative heating options increasingly expensive or uncomfortable. Data on HP installations over last years in Estonia are presented in the Table 2.

Table 2. Dynamics of HP installations in Estonia

	2000	2001	2002	2003	2004	2005	2006	%2006/2005
1. No of HP								
1.1.GSHP	86	183	312	360	440	565	750	132,7
1.2.Air-air HP	34	100	133	175	*	*	*	
1.3.Total	120	283	445	535	680	1083	2333	215,4
2. Inst. Capacity,kW								
2.1. GSHP	1023	2238	3760	3698	4695	6910	9300	134,6
2.2.Air-air HP	227	670	890	1023	*	*	*	
2.3.Total	1250	2908	4650	4721	5997	9324	17730	190,2
3. Heat prod.,GWh	3,6	8,1	12,9	13,1	16,6	25,9	49,5	191,1

Source: Estonian Union of Heat Pumps

5. CONCLUSIONS

HP solutions are increasingly popular in Estonia and a number of units installed annually is increasing. Practically all HP are used for HVAC purposes. No technological use have been identified.
Some problems can be identified :

- guidelines for selection of HP are needed for consumers. Few studies of HP operations results conclude that actual heat factor over longer period remains below the theoretically achievable level and contractors usually present only face value figures. Therefore, to achieve better practical results, instructions for consumers, how to select units and how to run them, would be useful;
- legal situation for HP development is satisfactory. In certain cases coordination of designs and construction works with local municipalities are required to avoid area development problems and meet environmental demands;
- potentially most promising sectors of industry in Estonia for HP applications are food industry, wood industry.

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