Renewable Energy Country Profile
Version 0.6b

These profiles are a work in progress. They are presented to the international community for review and comment. The profiles are undergoing continual updating for technical content, formatting, grammar, and other issues. Each country profile will be modified on a continuous basis as new information is made available.

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9.0 Estonia

9.1 Overview of Electricity Supply

Estonia gained independence from the Former Soviet Union in 1991. Since that time Estonia has worked to reform its economy.

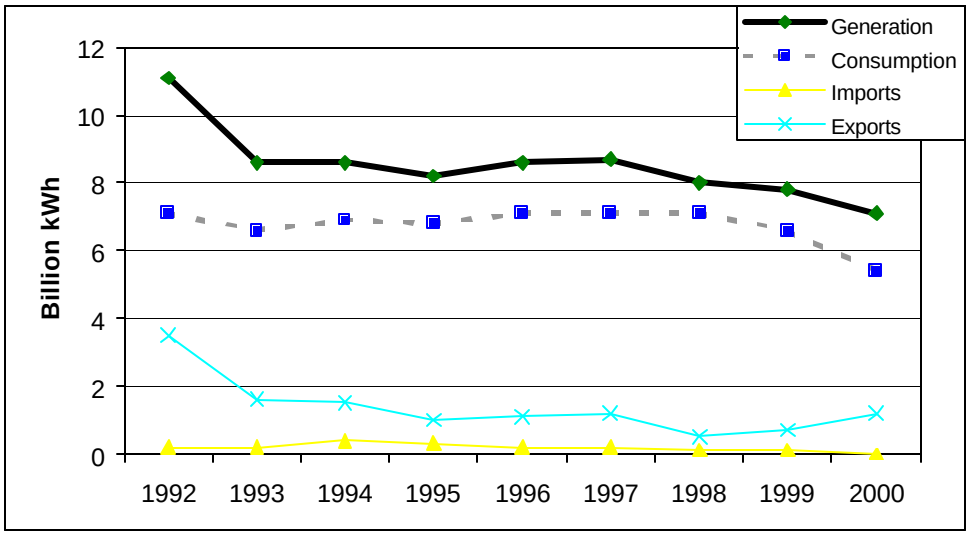
The Estonian electricity supply is made up almost entirely of oil shale thermal plants, as this is the vastly predominant natural energy resource in Estonia. The Estonian Power Station and the Baltic Power Station, both fueled by oil shale, together make up nearly 95% of Estonia's electric production. The remainder of the electricity is generated by other oil shale plants and Combined Heat and Power (CHP) Plants, which serve cities with heat in the winter months.

Table 9-1
Installed Generation Capacity

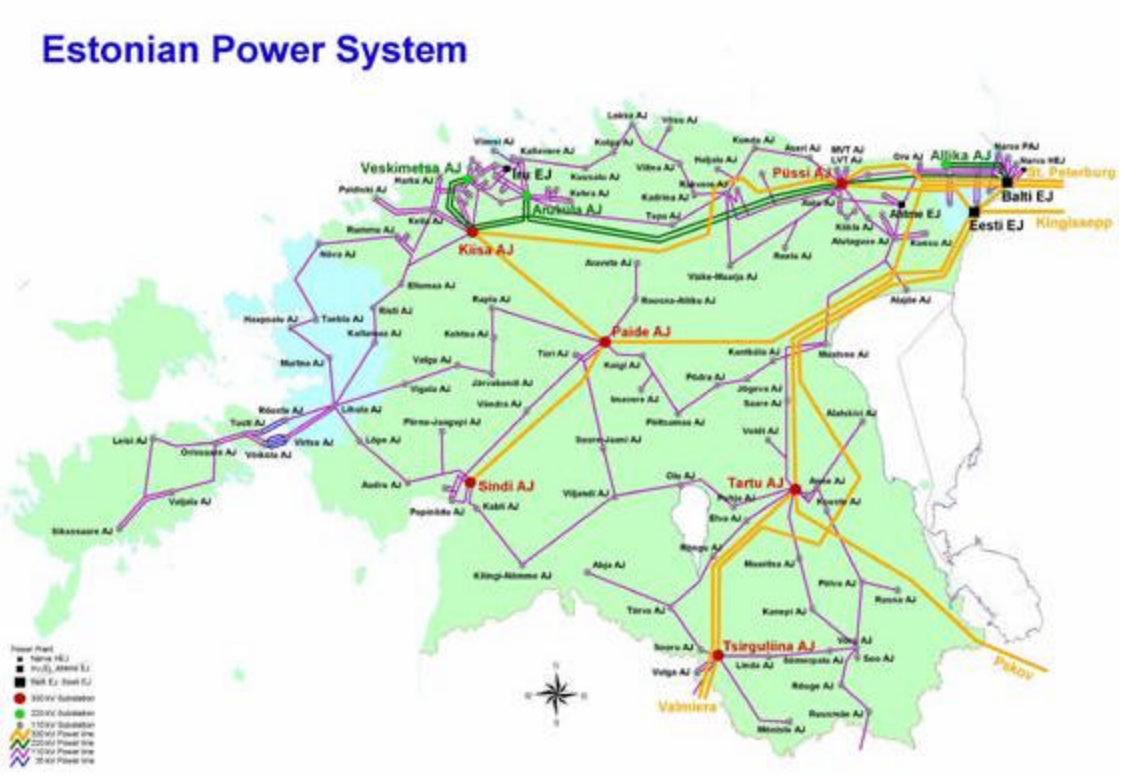
Fuel	Number of Units	Capacity (MWe)	Percent of Capacity
Nuclear	--	--	--
Coal	--	--	--
Oil Shale*	4	3,059	93.9%
Oil	1	9	0.3%
Natural Gas*	1	190	5.8%
Hydro	--	--	--
Other Renewables	--	--	--
Total	6	3,258	100%

*Facilities also produce heat in the form of steam as a output.

The generating capacity in Estonia has been sufficient to meet domestic demand throughout the 1990's as evidenced by the following figure. In addition, the electric sector has remained a net exporter of power over the same time frame.



(Language about transmission grid)



The energy sector in Estonia has two primary objectives: to provide a reliable source of energy for the country; and to provide such energy at the lowest possible cost. In order to accomplish these goals the government has sought to increase efficiency in the use of energy, reliable electricity generation and distribution, by seeking outside investment where applicable for infrastructure improvements, and by facilitating competition and diversity within energy industries. To this end the government began a phased-in liberalization of the

electricity sector in 2001. At this time tariffs were established to allow all customers to choose their electricity supplier, however, at this time only the customers whose annual use exceeds 40 GWh can now choose their electricity supplier.

Abb. 1: ***Wind Resources***

Current Status of Wind Energy [1), 2), 3)]

Currently there is only 150 kW operational wind power in Estonia.

A country wide wind-atlas is available, where several areas with annual average wind speeds of 7 - 8 m/s at 10 m height were identified. This corresponds to wind speeds over 10 m/s at 50m height.

A new energy law is expected by the end of 2002. Due to pressure from the EU to reduce CO_2 emissions by 8% in 2008 and to liberalize 37% of its market the new law is expected to be favorable for renewables.

The industry association is the Estonian Wind Energy Association. No industry manufacturer was identified.

Several project with a total of 76 MW installed capacity were identified. Notably the 20 MW project on Pladiski Peninsula, which will consist of 8 turbines of 2.5 MW installed capacity each.

Currently the government favors a feed-in tariff of 4.8 € Cents / kWh, where as developers are hoping for 6 - 8 € Cents/ kWh.

Estonia has a very good potential for wind energy development.

Wind Energy Resource Potential [4) 5)]

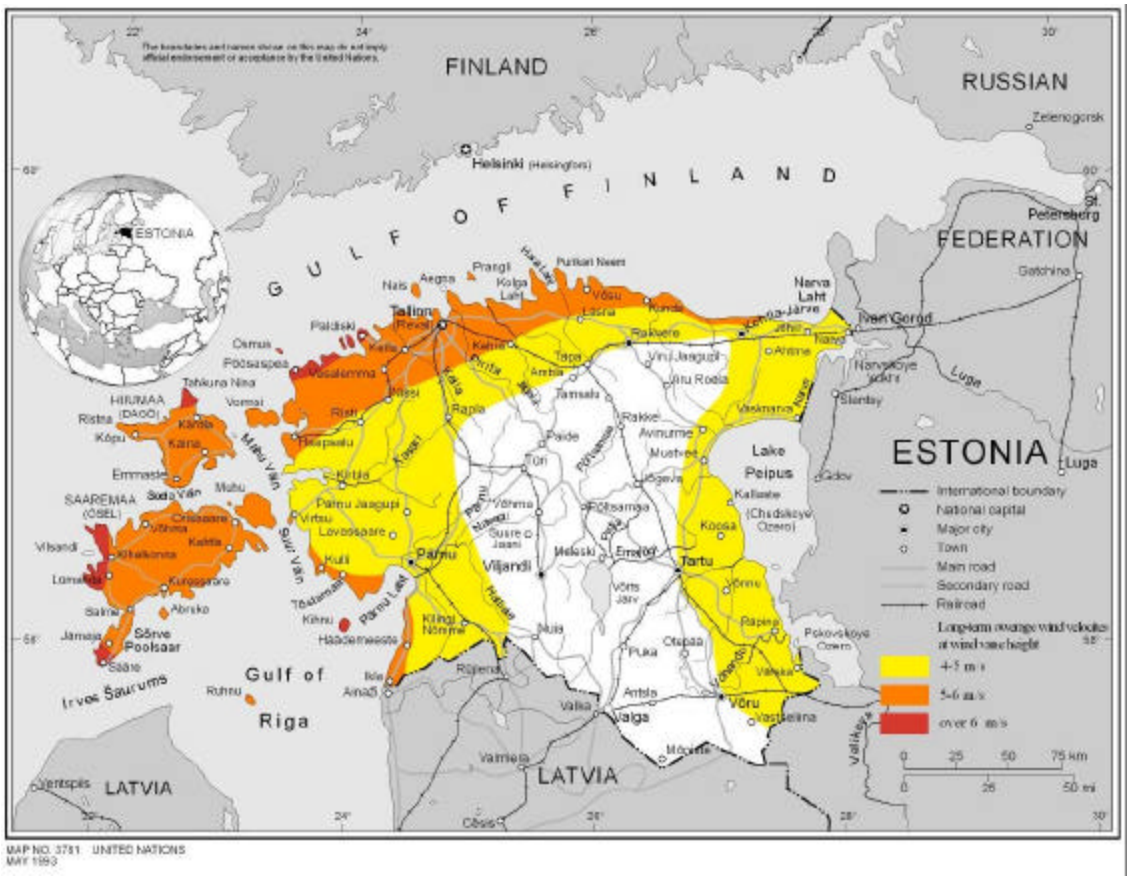
"Master Plan of Wind Power Development of the USSR till 2010", 1989 (MPWD) included a country-level wind map. The resource potential was estimated for 30m above ground. However, this wind map and its interpretation illustrates the limited validity of large scale resource potential assessments. According to this map the highest wind speed is simply above 6 m/s at 30m height, where as recent measurements show wind speeds as high as 8 m/s at 10m/s.

Nevertheless the technical wind energy resource potential of $17x10^9$ kWh/y technical potential estimated in above mentioned study is quite probably accurate. At an average capacity factor of above 30 percent, this would mean a total installed wind power capacity of 550 MW.

Under these circumstances we would rate the technical wind energy resource potential of Estonia as very good.

Identification of Areas/Projects with High Potential for Wind Energy[4)]

The Baltic Sea impact dictates the difference in wind regimes on the coastal line and in the inland regions. Wind resources suitable for power utilization are available on approximately 20% of the territory. Quality of wind potential in the coastal zone is higher than that in the other Baltic countries.



Wind atlas of Estonia

Table 1-2 Estonia Areas/Projects with High Potential for Wind Energy..

Project Name and Location	Size (MW)	Description
Tahkuna	10.5 MW	
Baltic Sea zone		Coastal strip of the Gulf of Finland and western coastal zone. Saaremaa and Hiyumaa islands (particularly high wind velocities are in the western area of the Saaremaa island).
West Estonian Archipelago		Wind Speed is up to 6-7m/s at 10m height.
Western coast of Saarema		Wind Speed is up to 4-8m/s at 10m height.
Inland regions		Eastern regions near the Chudskoye lake
Paldiski peninsula	20 MW	8 x 2.5 MW Nordex turbines
Prangli	30 MW	
Tamba West of Parnu	6 MW	Developer Ostwind of Germany
Hiyumaa island		

Barriers/Incentives for Wind Energy

Specific incentives for the implementation of wind projects in Estonia include:

- The most promising development has been the legal grid obligation for renewables in Estonia
- In Estonia, the fixed wind tariff equals 90% of the price paid by household customers; since the beginning of 1999, this has been EUR 0.048/kWh. The arrangement applies

only if the amount of renewables generated electricity in the previous year does not exceed 2% of total energy consumption in the country.

- Particular attention to the problems of environmental safety.
- Parliament has accepted laws about the %0 turnover tax of renewal energies and about the obligation of energy entrepreneurs to buy alternative energy with the price of %90 of the home tariff of electric energy.
- EU support.
- Changes in Energy Law open the possibilities for producing wind energy profitably and start manufacturing wind generators and their components in Estonia. First joint-stock companies for utilization wind energy in areas with best wind conditions are established. A lot of wind energy companies from Middle Europe and Scandinavia are interested to make co-operation and invest in Estonia future wind parks.

There seems to be no specific barriers to the implementation of wind projects in Estonia other than small population and corresponding energy demand.

Table 1-3. Estonia Wind Energy Profile.

Current status of wind energy	
Installed capacity	0.15 MW, Genwind GV, At Cape Tahkuna, the northernmost point of Hiiumaa Island
Projects under construction	N/A
Supporting regulations?	Yes. Parliament has accepted laws about the %0 turnover tax of renewal energies and about the obligation of energy entrepreneurs to buy alternative energy with the price of %90 of the home tariff of electric energy.
Industry association?	Yes. Estonian Wind Energy Association
Wind energy resource potential	
Level of information available	Good
Highest wind class	Class 7 (1'170 W/m^2)
Country-level wind atlas available?	Yes
Estimated potential (MPWD)	$8*10^{12}$ kWh/annum, gross (theoretical) potential $17*10^{9}$ kWh/annum, technical potential $200*10^{6}$ kWh/annum, economic potential
Estimated potential (EWEA)	550 MW, technical potential
Target established?	No
High windspeed locations	Baltic Sea zone
Identification of areas/projects with high potential for wind energy	
Recommended strategic assessments	Study 1 : site specific investigation of identified projects above 10 MW installed capacity Study 2 : an appraisal of legal and economical frame work
Identified areas/projects	• 10.5 MW, Tahkuna • 20 MW, Paldiski peninsula or Suur Pakri island • 30 MW, Prangli • 6 MW, Tamba West of Parnu (Ostwind, Germany)
Incentives/barriers for wind energy	
Significant incentives	• The legal grid obligation for renewables • The fixed wind energy selling price • %0 turnover tax for renewables energy sources
Significant barriers	• Small population

Overall Prospects	**Very Good** In Estonia wind power is already on its way to becoming an important energy source. Legal and economical frame work seems to be largely in place and there is a high public awareness. The only limiting factor seems to be local consumption but this will certainly change with cross border trading of CO_2 Credits

[1] Smoked fish and a great catch, How wind power development is catching sail in Estonia and floundering in Latvia; New Energy 4/2002
[2] Windblatt, das Enercon Magazin; 4/2002
[3] Wind Power Monthly, various issues
[4] "Master Plan of Wind Power Development of the USSR till 2010", 1989
[5] Situation of wind energy utilization in Estonia, A. Ots, V. Selg & A. Valma, Tallinn Technical University, Estonia

5.9 Estonia Renewable Energy Profile

5.9.3 Solar Resources

Current Status of Solar Energy

The utilization of solar energy in Estonia has no any noticeable spreading both for heat supply and electricity production.

Solar Energy Resource Potential

The solar energy resource potential is small in Estonia because of climatic conditions unfavorable for using solar energy and of northern latitudinal placement. The quantitative evaluation of this potential is given in Tables 1 and 2 for one point (Tiravere) located in the eastern part of the country.

Table 1

Monthly and annual total solar radiation incident on horizontal surface, MJ/m^2

Name of place	I	II	II	IY	Y	YI	YII	YII	IX	X	XI	XII	Yearly
Tiravere	48	112	283	389	551	631	588	452	277	129	46	29	3535

Table 2

Monthly and annual direct solar radiation incident on surface normal to sunlight beams, MJ/m^2

Name of place	I	II	II	IY	Y	YI	YII	YII	IX	X	XI	XII	Yearly
Tiravere	68	116	326	370	510	612	532	411	286	153	57	43	3486

The data of Tables 1 and 2 were borrowed from [1] and are the averaged values for observations period of many years.

Identification of Areas/Projects with High Technical Potential for Solar Energy

The territory of Republic is very small (only 45 ths. km^2). The climate is uniform for the overall territory. Therefore the data of Tables 1 and 2 can be distributed without any considerable mistake for the entire territory of the country. It follows that there are no zones or regions in Estonia with the considerable solar energy resource potential.

Barriers/Incentives for Solar Energy

The main barrier for development of using solar energy is a climatic one, which exclude the promotion and realization of any significant projects in the field of solar energy. At the same time the seasonal usage of solar water-heating plants and photovoltaic plants of autonomous purposes is possible.

Table 9 -3. Estonia Solar Energy Profile.

Current status of solar energy	
Installed capacity	Is practically absent.
Projects under construction	No data..
Supporting regulations?	Are absent
Industry association?	Are absent

Solar energy resource potential	
Level of information available	Fair
High range of solar insolation	0.5 – 0.75 kWh/m2/day [2] (worst month); up to 2.7 kWh/m2/day (year average [1])
Country-level solar atlas available?	No.
Target established?	No data.
High solar insolation locations	The solar climate is homogeneous. There are no regions or points with the higher level of solar radiation.
3 Identification of areas/projects with high potential for solar energy	
3.1Recommended strategic assessments	Technical-and economic analysis of possibilities of commercial application of seasonal solar plants for different consumers.
3.1 Identified areas/projects	Due to the unfavorable climatic conditions, the allocation of any significant projects in the field of solar energy is not expedient.
4 Incentives/barriers for solar energy	
4.1 Significant incentives	Shortage of own energy resources.
4.2 Sig1nificant barriers	Unfavorable climatic conditions.
Overall Prospects	Poor mainly because of unfavorable climatic conditions.

References

1. Applied scientific reference book on climate of the USSR. Hydrometheoizdat, l., Issue 4, L., 1990.
2. Internet site: www.bpsolar.com/ContentDocuments/17/PV System Sizing Tools.zip

5.9.4 Geothermal Resources

Current Status of Geothermal Energy

The geothermal conditions at Estonian territory are unfavorable: maximum thickness of sedimentary rock over Precambrian crystalline basement never exceeds 700 m; geothermal gradient is lower than the average level. The thermal water was not found. National program of using geothermal resources is absent [1].

Geothermal Energy Resource Potential

Evaluation of geothermal resources was not carried out.

Identification of Areas/Projects with High Potential for Geothermal Energy

High potential geothermal resources for electricity production are absent.

Barriers/Incentives for Geothermal Energy

Main incentive for using thermal water in Estonia is a shortage of own fuel.

Specific barriers to the implementation of geothermal projects in Estonia include:

– unfavorable geothermal conditions.

Table 24-4. Estonia Geothermal Energy Profile

Current status of geothermal energy	
Installed capacity (electric)	0
Installed capacity (thermal)	0
Projects under construction (electric)	0
Supporting regulations?	No
Industry association?	No
Geothermal energy resource potential	
Level of information available	Fair
Country geothermal atlas available?	No.
Estimated potential (electric)	0
Target established?	No
High enthalpy geothermal locations	Absent
Identification of areas/projects with high potential for geothermal energy	
Recommended strategic assessments	No
Identified areas/projects (electric)	No
Incentives/barriers for geothermal energy	
Significant incentives	**Shortage of own fuel resources.**
Significant barriers	**Unfavorable geothermal conditions.**
Overall Prospects	Poor. Unfavorable geothermal conditions make geothermal energy use non-prospective.

References

1. A Strategic Plan for the Development of European Geothermal Sector. *Blue Book on Geothermal Resources,* European Communities, 1999.

5.24.5 Biomass Resources

Current Status of Biomass Energy

The references of information don't contain the data on projects realized for using biomass for energy purposes in Estonia.

Biomass Energy Resource Potential

Table shows the overall biomass resource data for Estonia.

Estonia Biomass Resource Data (FAO 2002a, FAO 2002b).

Biomass resource type	Total production	Production density
Primary crop production, tonne	(avg. 1999-2001, tonne)	(tonne /1000 Ha)
Total primary crops (rank among COO)	8,366,355 (16)	1,979 (12)
Top 10 primary crops		
Grasses (misc), Forage & Silage	3,693,333	874
Mixed Grasses, Legumes	3,516,667	832
Potatoes	425,116	101
Barley	272,552	64
Wheat	122,132	29
Oats	90,527	21
Vegetables and Roots, Fodder	50,974	12
Rye	46,800	11
Rapeseed	36,172	9
Mixed Grain	23,686	6
Animal units, number	(number)	(number / 1000 Ha)
Cattle	287,400	68
Poultry	2,549,000	603
Pigs	306,050	72
Equivalent animal units	435,310	103
Forest products, cubic meters	(avg 1999-2000, cu meters)	(cubic meters /1000 Ha)
Wood fuel and charcoal	1,222,812	289
Wood residues	270,000	64

The area occupied by forests constitutes 22 thousand km2 that exceeds a half of the country territory.

Identification of Areas/Projects with High Technical Potential for Biomass Energy

The references of information don't contain the data on new projects for using biomass as energy source in Estonia.

Barriers/Incentives for Biomass Energy

The main restricting factor for production and construction of new biogas plants especially in agriculture consists of the relatively high investment expenses per a unit of power.

Table 24-5. Estonia Biomass Energy Profile.

Current status of biomass energy	
Installed capacity	No data
Projects under construction	No data
Supporting regulations?	Yes

Industry association?	No data
Biomass energy resource pote ntial	
Level of information available	Poor
Relative biomass potential (total / density)	Total: 3%; Density: 61%
Country-level biomass investigations available?	Yes
Estimated potential	No data
Target established?	Yes
High density biomass areas	No data
Identification of areas/projects with high potential for biomass energy	
Recommended strategic assessments	Study 1 Detailed evaluation of biomass potential for using in energy purposes. Study 2 Formation of a list of investment projects
Identified areas/projects	No data
Incentives/barriers for biomass energy	
Significant incentives	Considerable agricultural wastes
Significant barriers	The main restraining factor for production and construction of new biogas plants especially in agriculture consists of the relatively high investment expenses per a unit of power.
Overall Prospects	Fair

References

1. Energy and Environment. Presentation of Estonia. Round Table, 12-16 December 1994, Paris.
2. Estonia's Third National Communication Under the UN Framework Convention on Climate Change. 2001.
3. Economy of the USSR in 1990. Statistical yearbook/Goscomstat of the USSR. – Finances and Statistics, 1991.

Renewable Energy Profile (draft)

REPUBLIC OF ESTONIA

HYDRO POWER POTENTIAL FOR DEVELOPMENT OF SMALL AND MEDIUM SIZE HYDRO

According to the adopted classification, small HPPs are of capacity up to 30 MW, medium-size HPPs are of capacity up to 100 MW.

1. Current State of Hydro Power

There are no large and medium-size HPPs on the territory of Estonia. At present only one 1.2 MW HPP is existing.

2. Hydro Power Resources of Estonia

By absolute indices of potential hydro resources Estonia is on one of the last places among the CIS countries.

Hydro Power Resources of Estonia

Characteristics	Indices		Share of HPPs, % from the total
	Total	Including small HPPs of capacity up to 30 MW	
Gross theoretical hydropower potential, - Billion kWh/year - concentration of power resources on the territory, thou.kWh/km^2	1.4 32	0.9	64.3
Technically feasible hydropower capability, Billion kWh/year	0.5	0.4	80.0
Economically feasible hydropower capability, Billion kWh/year	0.05	0.05	100
Power generated by existing HPPs, - Billion kWh/year - per cent of economic potential, %	Data are not available	Data are not available	Data are not available

At estimation of total hydropower potential of Estonia small hydropower were singled out. Small hydropower potential is spread over the whole territory of the Republic.

3. Plans for Development of Hydropower Potential

Programs of small hydropower development in Estonia include reconstruction and renovation of previously constructed small HPPs and construction of new ones.

Proposed Program for Development of Hydropower Potential (by documents prepared of 1990s)

Type of construction	Quantity	Installed capacity, MW	Average overyear power output, Million kWh	Note	Region
Rehabilitation of previously constructed small HPPs	19	4.8	15.47	Mostly former rural HPPs of capacity within 0.05-1.12 MW	Spread on the whole territory of Estonia

First Priority Potential Small Hydro Power Projects

Projects	Installed capacity, MW	Location
Rehabilitation of abandoned HPPs: Linnamae HPP	1.1	

4. Favorable Factors for Development of Hydro Potential:

- Own fuel resources are actually not available
- Power system deficiency

Bibliography

1. Power Resources of the USSR. Hydropower Resources. A.N.Voznesensky et al.,1967
2. Small Hydropower, L.P.Michailov et al, 1989
3. Periodicals: Hydraulic Construction, Power Stations, etc