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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17.0 Lithuania

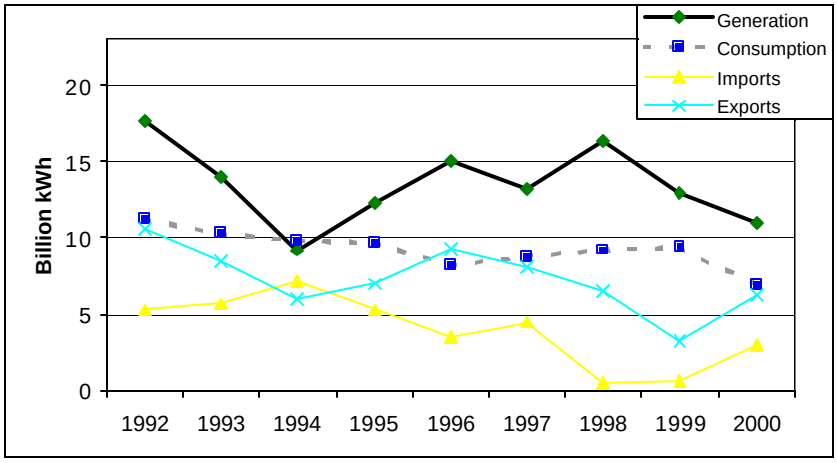
17.1 Overview of Electricity Supply

Electricity generation is predominantly nuclear in Lithuania, with the balance made up from thermal, natural gas and fuel oil, CHP plants used for district heating. As Lithuania is predominantly flat-lands there are not considerable hydroelectric resources, however, this resource is utilized to about half of its potential of 1600 MWe. Following is a summary of the major electric generating facilities in Lithuania.

Table ___
Installed Generation Capacity

Fuel	Number of Facilities	Capacity (MWe)	Percent of Total
Nuclear	1	2,500	42.7%
Coal	--	--	
Fuel Oil	1	100	1.7%
Natural Gas/Fuel Oil	6	2,352	40.1%
Hydro	3	909	15.5%
Other Renewables	--	--	
Total	11	5,861	100%

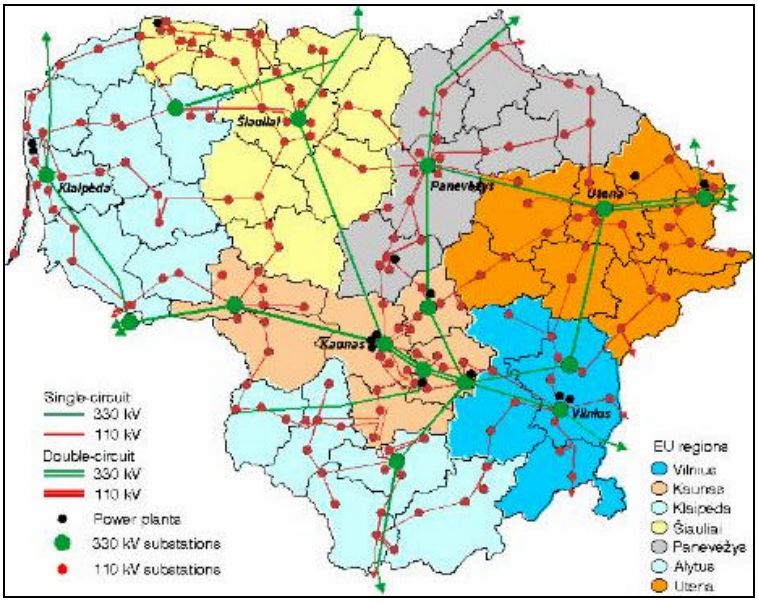
Additional fuel oil and natural gas facilities are in operation that provide only district heating to communities across Lithuania.



The current electric generating capacity is capable of providing power well in excess of the amount needed for domestic consumption. The primary source of generation, the nuclear plant, needs significant investment in order to continue operation through 2025. Barring this investment the plant will need to be shut down in the 2005 to 2010 time period.

Despite the nuclear facility, there are plans in place to expand hydroelectric generation and traditional thermal generation.

The transmission grid in Lithuania has deteriorated considerably since the fall of the Former Soviet Union, with estimated repairs in the range of $330 million. However, there are plans in place to begin the process of modernization and expansion of the existing grid. There is currently in place an agreement with Poland to build a transmission line to connect the grids in these countries. Additionally, _____, a British company has expressed interest in investing $100 million in order to expand the eastern European grid into western Europe.



Privatization of the Lithuanian Energy Company has proceeded gradually in a stepped manner over the course of the 1990's. In August of 1999 guidelines for restructuring the Lithuanian energy company were accepted by the government by which 51% of the company's generating capacity and distribution would be sold. Bids were accepted in September of 2000, however, it is still unclear when the system will be fully privatized. In January of 2001 the Lithuanian Parliament passed a law on restructuring with a new plan to split the Lithuanian Energy Company into 5 separate companies. Under this plan the generation, transmission, and distribution assets will be separate entities.

The first step was to set up the company as a corporation and set it operating on a commercial basis. Secondly, the CHP operations were separated from the company whereby several municipalities were formed. The nuclear assets were then separated from the non-nuclear assets. The next step will be a move towards competition with several small players in the market.

1.1.1 Wind Resources

Current Status of Wind Energy [1)]

No wind turbines operate in Lithuania, where favored renewable energy sources are biomass and small hydro plant. A 4 MW demonstration wind project is on the drawing board for a site at Butinge on the Baltic Sea coast, where the wind blows at 4.5-5 m/s at a height of ten meters height. However financing for the project has not yet been secured. Lithuania has the highest dependence on nuclear power in its electricity supply of any country in the world, supplied by a single nuclear plant, Ignalina.

In the nearest future no renewable power sources are proposed to be used in electric power balance. Possible only is preliminary elaboration of some pilot projects. In the past years it was proposed construction of wind power plant with installed capacity of up to 10 MW in the scope of Master Plan of Power Development of the Kurshskay Spit. But it was not determined what part of the wind power plant would be on territory of Lithuania.

A country wide wind-atlas is available, which indicates wind speeds over 6 m/s at 30 m height mainly at the Baltic coast.

No industry association was identified.

No other projects, besides the total 14 MW mentioned above has been identified.

Lithuania has a very good technical potential for wind energy development.

Wind Energy Resource Potential [2)]

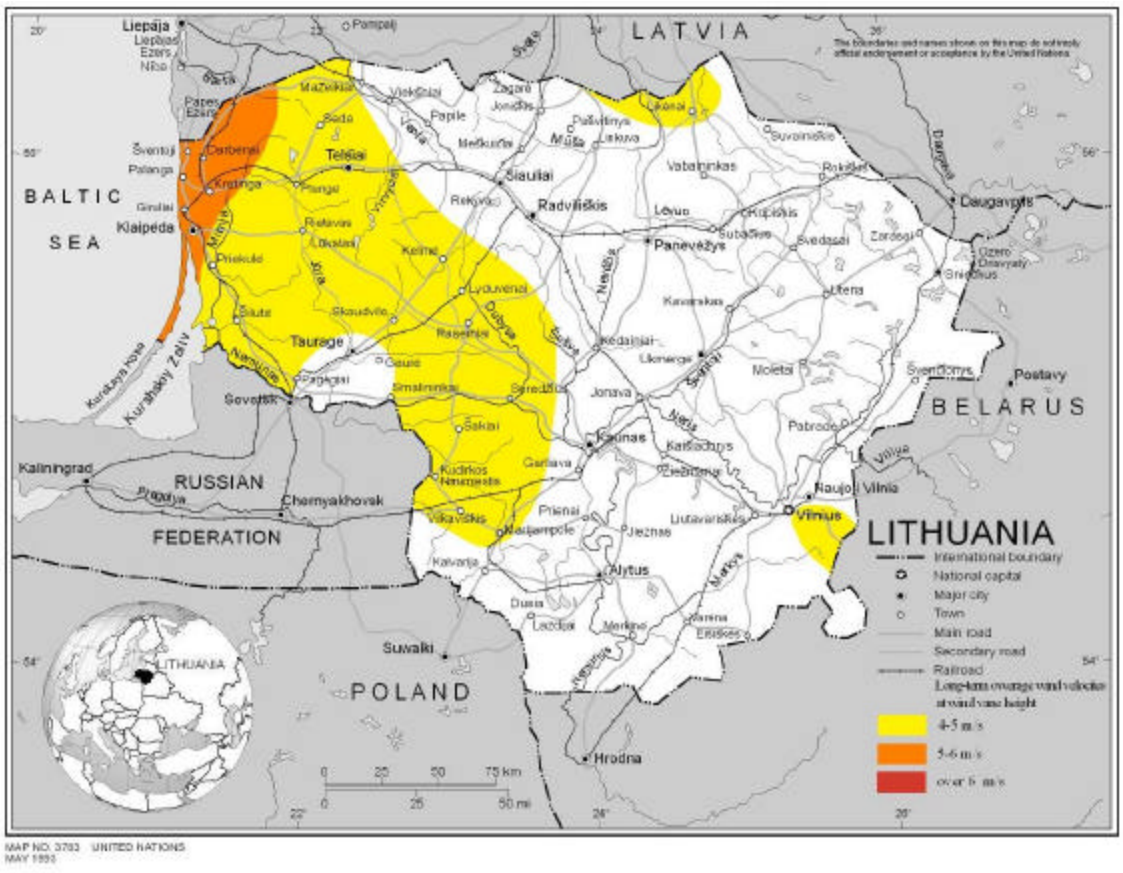
"Master Plan of Wind Power Development of the USSR till 2010", 1989 (MPWD) included a country-level wind map. The Baltic Sea impact dictates the difference in wind regimes on the coastal line and in the inland regions. Wind resources suitable for power utilization are available more than on 10% of the territory in the western region of the country.

If we compare with the findings for Estonia and Latvia the $10x10^9$ kWh/y technical potential estimated in above mentioned study is quite probably not accurate. Therefore we would set the total potential wind power capacity at 500 MW.

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

Identification of Areas/Projects with High Potential for Wind Energy

The most promising sites are Palanga, Klaipeda, Kurshskay Spit and the western region of inland territory



MAP NO. 3793 UNITED NATIONS
MAY 1993

Wind atlas of Lithuania

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

Project Name and Location	Size (MW)	Description
Palanga		
Klaipeda		
Kurshskay Spit		
Western region of inland territory		

Barriers/Incentives for Wind Energy

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

- Green certificate
- Particular attention in the country to the environmental safety problems, especially in the zones of resorts.
- Principal possibility of joint operation of wind power plant with Kruoniss pumped-storage plant.

Specific barriers to the implementation of wind projects in Lithuania include:

- Highest nuclear power generation dependency, low electricity prices and lack of interest in technology.

Table 1-3. Lithuania Wind Energy Profile.

Current status of wind energy	
Installed capacity	None
Projects under construction	None
Supporting regulations?	None
Industry association?	Lithuanian Energy Institute
Wind energy resource potential	
Level of information available	Good
Highest wind class	Class 7 (must be similar to Latvia)
Country-level wind atlas available?	Yes.
Estimated potential (MPWD)	$10*10^{12}$ kWh/annum, gross (theoretical) potential $11*10^{9}$ kWh/annum, technical potential
Estimated potential (Interwind)	500 MW
Target established?	No
High wind speed locations	Baltic Sea zone
Identification of areas/projects with high potential for wind energy	
Recommended strategic assessments	Study 1 : Instead of a study an advertisement campaign, or an educational program for increasing public awareness should be launched. Study 2 : an appraisal of legal and economical frame work
Identified areas/projects	• 4 MW, at Butinge on the Baltic Sea coast 10 MW, Pilot project, Kurshskay Spit
Incentives/barriers for wind energy	
Significant incentives	• Green certificate
Significant barriers	• Cheap energy sale price to the end user • No public awareness • No governmental interest
Overall Prospects	**Fair** The wind energy development prospects are fair in Lithuania all the country has very good wind energy resources like Estonia and Latvia. This is largely due to lack of public and government awareness

1) Wind Power Monthly, various issues

2) "Master Plan of Wind Power Development of the USSR till 2010", 1989

5.15 Lithuania Renewable Energy Profile

5.15.3 Solar Resources

Current Status of Solar Energy

The using of solar energy is poorly developed in Lithuania. In Republic there are no any incentives or projects in this field. Recently solar energy has been utilized for hot water supply, space heating of premises and drying of agricultural production. Small amounts of solar cells and autonomous electricity sources are produced as well. Preliminary estimations show that passive solar system could save about 15-20% of energy demand for space heating of buildings.

Solar Energy Resource Potential

On the whole the climatic conditions are not favorable for using solar energy, and therefore the solar energy resource potential is small. It is characterized by the data presented in Tables 1 and 2 for two points – Kaunas and Shilute. The first one is located in a central part of the country, while the second one – in the western part near Baltic coast.

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
Kaunas	62	122	283	401	568	626	579	484	317	154	54	40	3690
Shilute	51	107	261	363	543	617	568	454	287	144	54	35	3484

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
Kaunas	61	117	284	301	472	545	453	408	288	158	54	47	3188
Shilute	46	101	243	310	454	519	418	349	251	132	43	43	2909

The data presented in Tables 1 and 2 were taken from [1] and are the values averaged for observations' period of many years. Although Lithuania is located between 53^0 54' and 56^0 27' North latitude the total radiation to the horizontal plane surface is approximately equal to 1000 kWh per year. The total annual amount of solar energy falling on the whole territory of the country is equal to 65 million GWh. The maximum solar irradiation to the horizontal plane in the midday of June, as it follows from Tables 1 and 2, is 600 W/m^2 in the average cloudness and reaches even more than 1000 W/m^2 at the sunny clear sky. It means that utilization of solar energy for satisfaction of heat demand is rather promising [2].

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

The territory of Republic is not large. The climate is not homogeneous that is confirmed by the data from Tables 1 and 2. Regions or local zones, where the solar energy potential is sufficient for the commercially effective use, are absent.

In general there is the lack of accurate data about the using of solar energy in the country.

Barriers/Incentives for Solar Energy

The main barrier for using solar energy is a climatic one. Insufficient solar energy potential makes it not expedient to promote any large projects. At the same time the seasonal using of solar water-heating plants and photovoltaic plants is possible.

Table 15-3. Lithuania 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	0.7 – 1.0 kWh/m2/day [3] (worst month); up to 2.8 kWh/m2/day (year average [1])
Country-level solar atlas available?	No.
Target established?	No data.
High solar insolation locations	There are no regions or points with the high level of solar radiation.
3 Identification of areas/projects with high potential for solar energy	
Recommended strategic assessments	Technical-and economic analysis of possibilities of commercial application of solar energy for different consumers.
Identified areas/projects	Due to the unfavorable climatic conditions, the allocation of any significant projects in the field of solar energy is not expedient.
Incentives/barriers for solar energy	
Significant incentives	Shortage of own energy resources.
Significant 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 6, 1990.
2. Vrublyauskas S. (Lithuania, Kaunas, Lithuanian Power Engineering Institute), Kruzhinskas V. (Lithuania,Vilnius, Ministry of the Environment of the Republic of Lithuania). “Possibilities of utilization of renewable energy sources as means for greenhouse gas mitigation in Lithuania”. Proceedings of II International Conference “Reduction of methane emission”, Novosibirsk, 2000.
3. Internet site: www.bpsolar.com/ContentDocuments/17/PV System Sizing Tools.zip

5.15.4 Geothermal Resources

Current Status of Geothermal Energy

The geothermal resources are presented in Lithuania by geothermal brines with temperature up to 90 ?C and TDS up to 200g/l [1]. Three experimental heat supply systems are currently under construction including the usage of heat pumps. The planned total thermal power is 70 MWt. The financing is carried out with attraction of the grants of International funds and credit of World Bank. Development of geothermal energy is foreseen in National Energy Strategy and in National Energy Efficiency Program.

Geothermal Energy Resource Potential

The most prospective geothermal reservoirs are discovered in Devonian and Cambrian high permeable sandstones at the depths up to 2100 m in the western part of Lithuania. The local and regional evaluations of extracted heat with full reinjection of waste brine were fulfilled, but the overall possible thermal power was not determined.

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 Lithuania is a shortage of own fuel resources.

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

1. Insufficient experience of geothermal fields operation with full reinjection.
2. Low tariffs for heat.

Table 15-4. Lithuania 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	Good
Country geothermal atlas available?	No
Estimated potential (electric)	0
Target established?	Yes
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	1. Shortage of own fuel resources.
Significant barriers	1.Insufficient experience of geothermal fields operation with full reinjection.

	2. Low tariffs for heat.
Overall Prospects	Good. Existence of geothermal brine resources together with supposed growth of heat tariffs can make profitable the geothermal heat supply.

References

1. A Strategic Plan for the Development of European Geothermal Sector. *Blue Book on Geothermal Resources*, European Communities, 1999.
2. P.Suveizdis *et al*. Geothermal Potential of Lithuania and Outlook for its Utilization. *Proceedings World Geothermal Congress 2000,* Tokyo, 2000.

5.15.5 Biomass Resources

Current Status of Biomass Energy

Wood fuel was used in Lithuania for space heating of individual houses burning it in stoves with small efficiency. It continued till the middle of 1990s.

In 1994 waste wood and specially prepared wood chips were started to burn in the district heating boilers with higher capacity (> 1 MW). Every year new combustion wood boilers or refurbished existing ones by adapting them for wood fuel are commissioned. Now total installed capacity of such combustion wood boilers achieves around 120 MW. In accordance with the statistic data of 1998 the consumption of wood fuel was equivalent to 571 ktoe.

Straw. The using of straw fuel in Lithuania was started only since 1996. The total installed capacity of straw-fired boilers makes up about 5 MW. Approximately 7500 t of straw is burned annually in these boilers. This amount is equivalent to 2.5 ktoe of primary energy.

Biogas. At present biogas is produced in two wastewater treatment plants (Kaunas and Utena cities), in distillery "Serna" (Panevezys city) and in the demonstration biogas plant of agricultural company "Vicia" (Kaunas region). The total volume of biodigesters is equal to 26000 m^3. The amount of biogas produced and utilized for power production makes up 4 million m^3 per year and is equivalent to 2.4 ktoe of primary energy.

Biomass Energy Resource Potential

Table shows the overall biomass resource data for Lithuania.

Lithuania 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)	20,525,473 (12)	3,168 (5)
Top 10 primary crops		
Mixed Grasses, Legumes	12,683,333	1,957
Potatoes	1,599,867	247
Vegetables and Roots, Fodder	1,457,567	225
Wheat	969,500	150
Barley	883,733	136
Sugar Beets	880,267	136
Grasses (misc), Forage & Silage	685,000	106
Rye	277,433	43
Maize for Forage & Silage	205,667	32
Cabbages	122,600	19
Animal units, number	(number)	(number / 1000 Ha)
Cattle	910,300	140
Poultry	6,560,000	1,012
Pigs	1,047,550	162
Equivalent animal units	1,394,920	215
Forest products, cubic meters	(avg 1999-2000, cu meters)	(cubic meters /1000 Ha)
Wood fuel and charcoal	1,162,095	179
Wood residues	1,200,000	185

Wood fuel. Wood is one of the kinds of biomass that is most widely used in power plants as a fuel. An area of forests and volumes of logging determine the resources of wood fuel. Forests cover 1978 thousand hectares or 30.3% of total land area of Lithuania. The gross annual in-

crement constitutes approximately 11.6 million m^3 of wood. Recently the logging volumes in the country's forests have settled and correspond to 5 million m^3 a year including 700 ths. m^3 of firewood. The worthless firewood, waste wood of woodworking industry and felling residues can be used as a fuel.

Wood fuel resources can be enlarged by:

- Increasing volumes of felling,
- Intensifying utilization of felling residues,
- Growing short rotation forests and energy plants.

The felling volumes can be enlarged up to 6.3 million m^3 a year in the nearest future and up to 7.3 million m^3 in 10-20 years accordingly to the estimations of Forest Inventory and Management Institute.

The felling residues, which could be used as a fuel, make up about 1 million m^3 per year.

Sources of wood fuel can be replenished by growing short rotation energy plants. Such plantations have not existed in Lithuania till now.

Straw. The yield of straw constitutes about 3.5-4.0 million t every year. But not all yield of straw is collected. A part of it is used as a fodder or bedding matter, a part of it is used in a gardening and a part is left in the fields or lost. It can be assumed that about 10-12% of total amount of straw or 400 thousand t could be used as a fuel. Such amount of straw corresponds to 134 ktoe.

Biogas. It has been estimated that the technical potential of biogas production is equal to 530 million m^3 per year. It corresponds to 290 thousand toe of energy. The largest part of biogas resources consists of manure of domestic animals and poultry (94.3%). Wastewater of the largest cities of the country is at the second place (4.2%), while the organic wastes of food processing industry occupy the third one (1.5%).

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

Wood fuel. The preferred direction is a modernization of existing boilers and a construction of new ones for using the wood fuel.

It is planned to begin growing the first industrial plantation of energy plants on the recultivated peat swamp in Ezerelis (Kaunas region).

Straw. There are some companies in Lithuania producing straw-fired boilers. The capacity range of these boilers varies from 15 to 340 kW. Low capacity straw-fired boilers are designated for space heating of individual farmhouses. Large capacity boilers are designated for district heating systems of large objects or settlements located in the countryside.

Barriers/Incentives for Biomass Energy

Wood fuel. The largest part of felling volumes is not used up to now. Such situation is determined by some reasons: the collection and preparation of felling residues demands much manual labor and the special equipment is absent etc.

Biogas. The main restricting factor for production and construction of biogas-fired plants (especially in agriculture) consists of relatively high investments per unit of capacity.

Table 15-5. Lithuania Biomass Energy Profile.

Current status of biomass energy	
Installed capacity	Overall installed capacity of combustion-wood boilers is 120 MW Full installed capacity of combustion-straw boilers constitutes aboout 5MW. Volume of biogas used for energy production constitutes 4 million m^3 per year.
Projects under construction	No data
Supporting regulations?	Yes
Industry association?	No data
Biomass energy resource potential	
Level of information available	Fair
Relative biomass potential (total / density)	Total: 5%; Density: 66%
Country-level biomass investigations available?	Yes
Estimated potential	Technical potential of wood fuel constitutes more than 150 thousand toe per year. Technical potential of straw that can be used as a fuel constitutes 134 thousand toe Technical potential of biogas constitutes almost 200 thousand toe.
Target established?	Yes
High density biomass areas	No data
Identification of areas/projects with high potential for biomass energy	
Recommended strategic assessments	Study 1 Selection of priority investment projects Study 2 Development of Feasibility study of selected projects.
Identified areas/projects	No data
Incentives/barriers for biomass energy	
Significant incentives	1. Limited reserves of organic fuel. 2. Considerable timber resources. 3. Considerable agricultural wastes
Significant barriers	1. The largest part of felling volumes is not used up to now. Such situation is determined by some reasons: the collection and preparation of felling residues demands much manual labor and the special equipment is absent etc. 2. The main withstanding factor for production and construction of biogas-fired plants especially agriculture consists of relatively high investments per unit of capacity.
Overall Prospects	Good

References

1. Vrublyauskas S., Kruzhinskas V. Possibilities of utilization of renewable energy sources as means for greenhouse gas mitigation in Lithuania. Proceedings of II International Conference “Reduction of methane emission”, Novosibirsk, 2000.

Renewable Energy Profile (draft)

REPUBLIC OF LITHUANIA

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

Hydropower accounts for 4% of total generating capacity. Hydro installed capacity totals 112 MW. Recently 800 MW Kruonis PSP has been put into service.

Existing Hydro Power Plants in Lithuania

Hydro power plants	Installed capacity, MW	Share of HPPs in hydro power, %
Medium-size HPPs Kaunas	101	90
Small HPPs	11	10

2. Hydro Power Resources of Lithuania

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

Hydro Power Resources of Lithuania

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	5.4 83.0	1.5	27.8
Technically feasible hydropower capability, Billion kWh/year	2.8	0.7	25.0
Economically feasible hydropower capability, Billion kWh/year	2.2	Not determined	Not determined
Power generated by existing HPPs, - Billion kWh/year - per cent of economic potential, %	1.7 78	Data are not available	

Most part of hydropower resources is concentrated on the Nemunas River where four extra HPPs can be constructed.

At estimation of total hydropower potential of Lithuania 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 Lithuania include reconstruction and renovation of previously constructed small HPPs, adding small HPPs to water management projects with already existing water retaining structures with the aim of utilizing waste releases.

Proposed Program of Small Hydro Development (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	18	6	21	Mostly former rural HPPs of capacity within 0.11-1.64MW	Spread on the whole territory of Lithuania. Located near settlements
Adding HPPs to water management projects	43	20	63	Small HPPs of capacity within 0.1-1.7MW	Spread on the whole territory of Lithuania
Total	61	26	84		

4. Favorable Factors for Development of Hydro Potential:

- Own fuel resources are scarce

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