1. **Estonian biomass resources for energy sector. Implementation costs.**
Ülo Kask, Tallinn University of Technology, Institute of Power Engineering

2,25 Mha or 51,5% of the territory of Estonia is covered by forests which gives 462 Mm^3 of timber resource. According to ownership the forests can be divided as follows:

- National forest district – 830 000 ha (37%)
- Private forests – 680 000 ha (30%)
- Forests subject to the proceeding of Land reform – 710 000 ha (31%)
- Other state owned forests – 15 000 ha (1%)
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Annual cut is fixed in the Forestry Development Plan for the next 10 years – 7,81 Mm^3 for the years 1997-2001 and 12,6 Mm^3 for 2001 – 2010. Private forests are generally older that state owned forests. The following table presents the annual cut in Mm^3

Type of tree	Round log	Small log	Paper wood	Firewood	Waste	total
Pine	0,867	0,388	0,395	0,119	0,336	2,104
Spruce	1,171	0,470	0,647	0,419	0,489	3,196
Birch	0,411	0,330	0,921	0,409	0,520	2,591
Aspen	0,203	0,085	0,642	0,594	0,321	1,844
Black alder	0,051	0,052	0,203	0,122	0,105	0,533
Grey alder	0,022	0,091	0,927	0,794	0,496	2,330
Total	2,723	1,417	3,734	2,457	2,267	12,597
Sanitary cutting and thinning 0,5 Mm^3						

The next table describes the allowed cut of firewood in thousand m^3

	Ownership	Firewood	Branches and tops	Total	Primary energy content, TWh
Potential today	Private	2795,3	1349,6	4144,9	8,29
	State owned	443,2	452,5	819,9	1,64
	Total	**3238,5**	**1726,3**	**4964,8**	**9,93**
Forecast till 2032	Private	582,6	937,6	1520,2	3,04
	State owned	376,7	384,6	761,3	1,52
	Total	**959,3**	**1322,2**	**2281,5**	**4,56**

The most expensive fuel in Estonia today is light fuel oil – 406 EEK/MWh and the cheapest – wood waste – 50 EEK/MWh. Refined biofuels like pellets, wood briquettes and char coal are mostly used in households.

About one third of arable land is of low quality and not competitive for conventional agricultural crops – the more reason to think about using the waste products, like straw for energy production purposes. Today about 100 tons of straw could be used in boiler plants which equals to 400 – 600 GWh and in the coming years the amount may rise up to 200-250 tons ie 800 – 1000 GWh of primary energy. In other words thus we would be able to substitute 35 – 90 thousand tons of liquid fossil fuels.

Another source of renewable energy is biogas. 60% of manure produced in the Estonian farms could be used for biogas production giving annually about 500 GWh of primary energy. Biogas is already produced in landfills and sewage treatment plants. So far unused resource is wetland plants (reed, cattail) growing on more than 6000 ha. Artificial wetland, which work as sewage treatment systems are also excellent places for energy crop cultivation. One can find a number of systems already successfully functioning in Estonian villages. Wider use of reed and cattail for energy production is impeded by technical and logistical problems.

Total primary energy content of biomass in Estonia which could be used annually for energy production exceeds 20 TWh. Calculated primary energy content of willow plantations, agricultural waste, wetland plants and biogas is about 10,5 TWh/y, which is about 30% of fuels used in Estonia for electricity and heat production (36 TWh/y) in 2002.

2. Possibilities for solar energy application in Estonia and feasibility of investments

Teolan Tomson, Tallinn University of Technology, Institute of Material Science

In his presentation Mr Tomson gave a general introduction into the topic of solar energy, described schematically permanent variability of solar radiation in Estonia, presented heat pumps, solar energy heated domestic hot water systems and their prices, and the construction of solar collectors and PV systems. The presentation included also feasibility forecast for solar hot water systems till the year 2500. The case stories of solar applications included projects from Scotland, Australia and Estonia.

3. Development trends in wind energy applications in Estonia. Experiences with and possibilities of project funding.

Jaan Tepp, Estonian Wind Power Association

Estonia has committed to reach 5,1% share of renewable electricity by the year 2010. To meet the promises about 3,3% should come from wind farms. With the present annual consumption of 6 TWh it means installation of 90 MW of additional windmills or 15 MW per year. Installation cost of one MW is about 20 MEEK (ie 300 MEEK/y and 2 BEEK by 2010).

The present Energy Market Act states that the network operator shall purchase the electricity generated from a renewable energy source at a price equal to the weighted average price of electricity sold by the producer possessing generating installations with a total net capacity of at least 500 MW during the previous calendar year in accordance with the prices for which the producer has obtained approval from the Energy Market Inspectorate multiplied by a coefficient of 1,8. The Estonian Wind Power Association has made a proposal to increase the above coefficient to 2.21 including corresponding changes to the present Energy Market Act.

Estonian energy policy is unfortunately not very renewable friendly. Purchased prices are much lower that for instance in Germany – 87 cents/kWh till 2015 in Estonia compared to 125 cents/kWh with no time limit. Another problem is that favourable winds blow in the regions with poor grid connection. Technical barriers are set by the peculiarities of Narva Power Plants. Funding sources are limited and loan conditions are not encouraging. But the project development requires at least 1 – 1,5 years, including project planning, impact assessments, application for necessary licenses, contracts and agreements, construction works etc. Possible funding sources are own resources, bank loans, commercial leasing, grants of the Centre of Environmental Investments, bilateral aid programmes, joint implementation projects and emission trading, export credit etc.

Today there are 7 windmills in Estonia, 8 more will be added during 2004

4. Reconstruction of district heating systems. Feasibility of investments.

Pavel Bogdanov, OÜ Märja Monte, Mari Habicht, Archimedes Foundation

The presentation describes a typical situation with heat production and heat consumption in an Estonian village and gives the basics of an average energy development plan of a municipality. The biggest share in the heat price goes to fuel (42%) followed by wages (32%), other costs (19%) and electricity (7%). High price of conventional fossil fuels used in district heating makes the local administrations to look for cheaper alternatives. Feasibility studies and economic analyses are the bases for the selection between two possibilities: either local boiler house burning light fuel oil or wood based fuel or district heating burning heavy fuel oil or local fuels (wood, peat). Special attention is paid to taxation in the EU Member States including VAT and environmental taxes and the tendencies in Estonia.
Another important criteria for selection in investment cost which may vary from 1200 to 4000 EEK/kW and the eventual price of heat produced in the reconstructed or new boiler plant. As a rule the reconstruction of district heating systems in rural settlements is economically reasonable. Today the most perspective fuel is wood.
The presentation ended with a case story from Estonia – Avinurme district heating system and an example from Austria – Güssing, which changed from an underdeveloped and poor region to one of the richest regions of the country thanks to implementation of renewable energy concept.