Renewable energy from biomass in Estonia: current status and outlook

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    1.2. Land resources
2. Renewable energy in Estonian strategy documents
3. Existing competence- what has been done?
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1. Why renewable energy in Estonia?

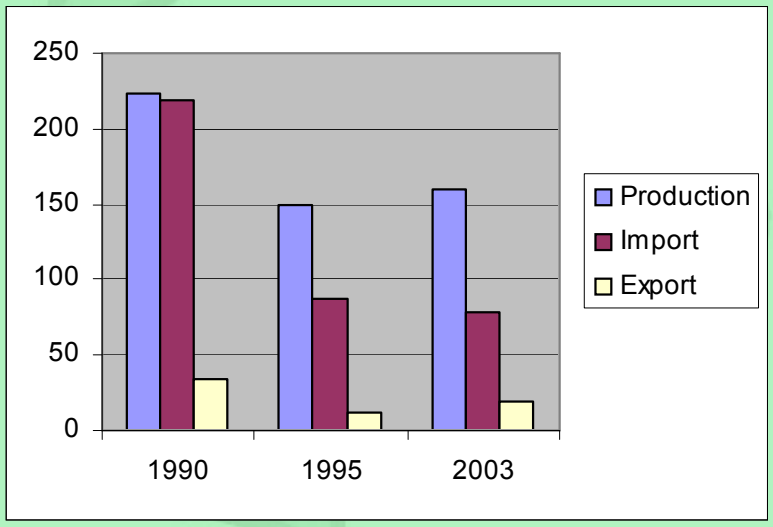
Structure of energy production, import and export in Estonia (TJ)

Source: Statistical Office of Estonia

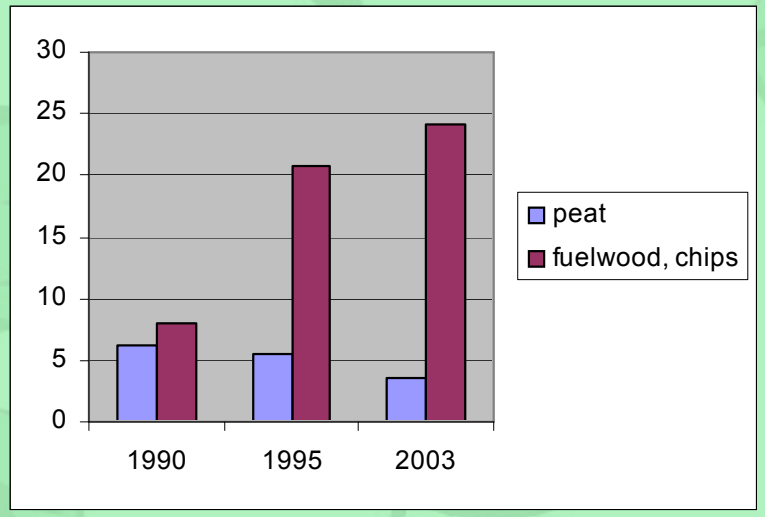
	1990	1995	2003	Notes
Production	**224**	**149**	**160**	**1**
oil shale	210	122	132	
peat	6,2	5,5	3,5	4
firewood, chips	7,96	20,7	24,2	4
Import	**219**	**88**	**79,1**	**2**
coal	9,4	2,7	1,6	
oil shale	22	12,5	8,9	
gas	52,1	24,6	27,8	6
fuel oil	73,4	18,5	3,6	
diesel oil, gasoline	54	13,5	36,2	7
Export	**33,9**	**11,6**	**19,9**	**3**
oil shale	2,1	1,1	0,9	
peat	0,3	0,5	2,4	5
oil-shale oil	0,8	5,8	6,4	
electricity	30,5	3,6	7,1	
firewood	0	0,5	2,9	5

1. Why renewable energy in Estonia?

Structure of energy production, import and export in Estonia (TJ)



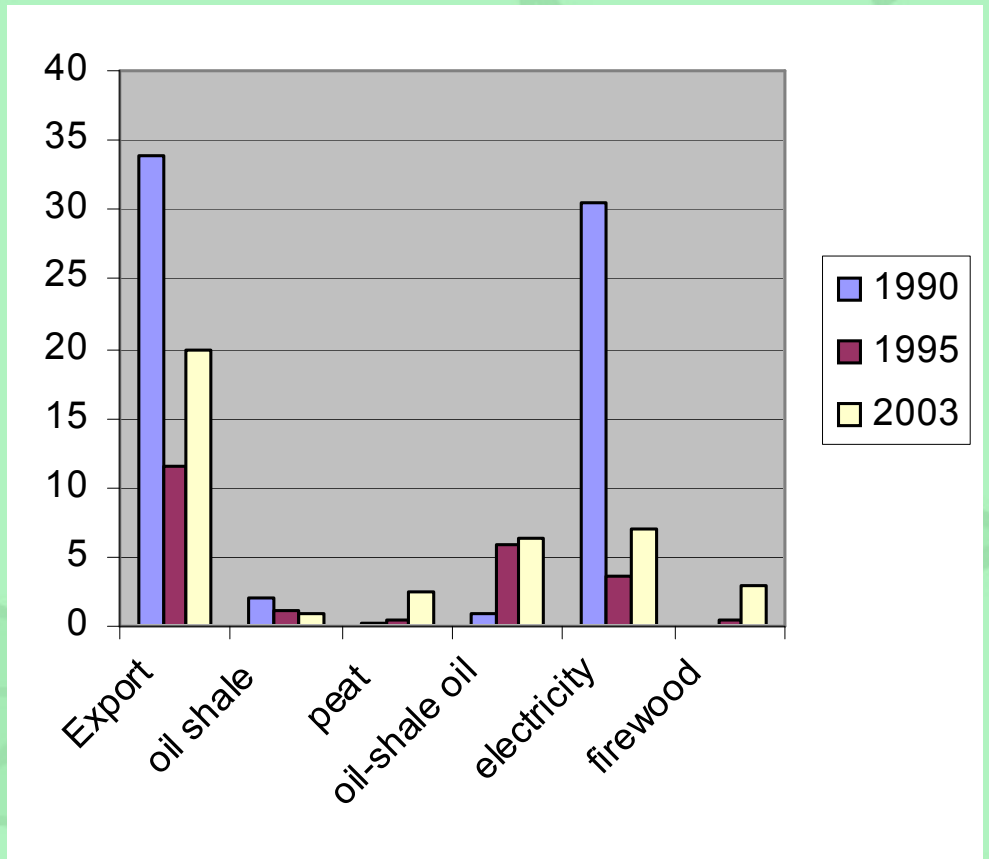
1. Energy production dropped rapidly and stabilised
2. Import declined and is still declining
3. Export is slowly growing



4. Production of renewables (firewood) increased 3 times

1. Why renewable energy in Estonia?

Structure of energy export in Estonia (TJ)



5. Firewood export is growing fast, most of peat exported
6. Gas import growing
7. Petrol and diesel oil import growing

1. Why renewable energy in Estonia?

Structure of energy production, import and export in Estonia

Conclusions from the statistical data:

- Domestic traditional renewable sources of energy almost exhausted
- Prices of firewood and woodchips rising fast

1. Why renewable energy in Estonia?

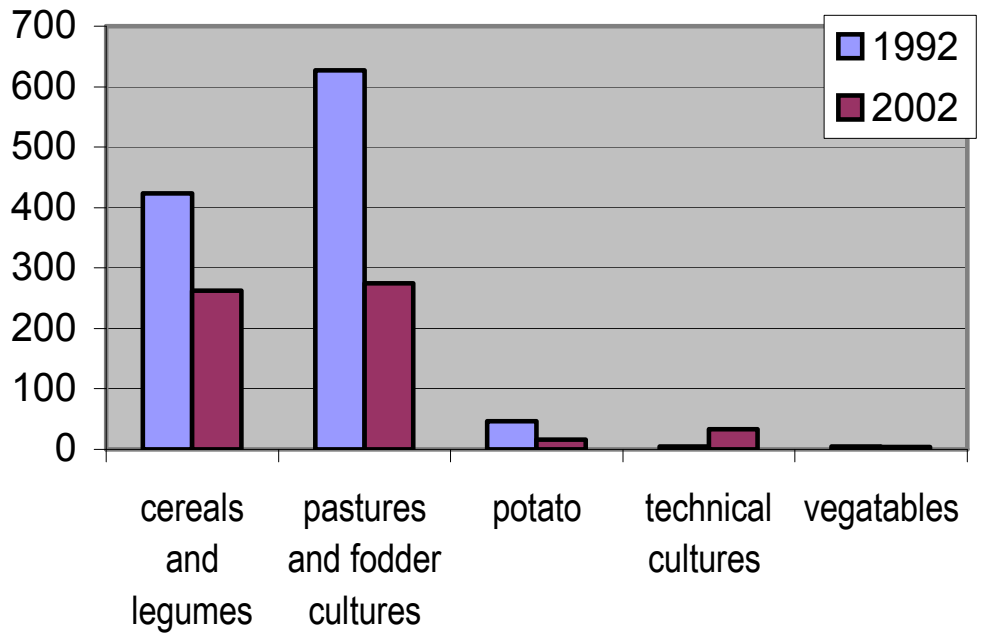
Structure of energy production, import and export in Estonia

Results of the current situation:

- Possibility that recently reconstructed wood- fired- boilers will be converted to gas
- Heat producers revitalised the renewable energy project

1.2. Why renewable energy in Estonia?

Structure of agricultural land use in Estonia



1.Rapid decline in arable land use

- Cereals:--161
- Pastures -353

2.One exception: rapeseed (33 → 46 th ha 2002→ 2003)

3.Totally >440 th ha abandoned (approx 40% of arable land)

1.2. Why renewable energy in Estonia?
442 th ha abandoned

(Source: Estonian Ministry of Agriculture)

How to exploit this resource?

1. Let the nature rule!
   - Approx 10-15% of abandoned areas - natural forestation
2. Afforestation programmes
   - Approx 700 ha of hybrid poplar
3. Energy crops
   - Rapeseed (rapidly expanding – 2003 approx 46 th ha)
   - Short rotation forests (no commercial plantations exist)
   - Other energy cultures - ? Only discussions

2. The role of renewable energy in Estonia

Strategy documents

Estonian long-term energy development plan 2015 (adopted in Parliament 15.12.2004)

- Stabilisation of energy consumption on the level of 2003
- The share of renewable electricity should grow to 5.1% by 2010 (wind, co-generation)
- Emphasis on renewable liquid biofules, especially biodiesel
- Solid biofuels? - Sceptical attitude
  - Stated, that the export is growing and therefore the resources of domestic biofuel are exhausted
  - For further development of biomass plantations economic calculations are needed.

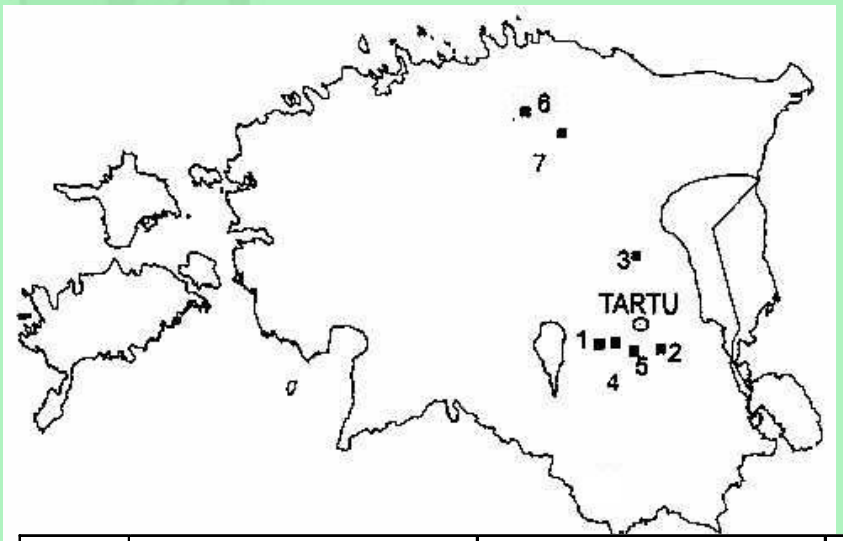
3. Existing competence – what has been done?

SRF plantation in Estonia - two goals

- Energy production

- Waste utilisation

3.1. Existing SRF test plantations in Estonia



No	Location	Area (ha)	Established in	Studies
1	Tõravere	0.2	1993	Light use efficiency
2	Kambja	0.3	1993	Productivity
		16	2003	Seasonal wastewater purification
3	Saare	0.6	1993	Productivity, fertilisation effect
4	Nõo	0.4	1994, 1995	Municipal sludge utilisation
		0.4	2001	Clone selection
5	Aarike	0.18	1995	Wastewater purification
6	Vohnja	4.1	2003	Annual wastewater purification
	Kihlevere	1.45	2003	Freeflow wastewater purification & constructed wetland
7	Väike-Maarja	0.2	1993	Wastewater purification

3.2. Productivity studies Saare plantation

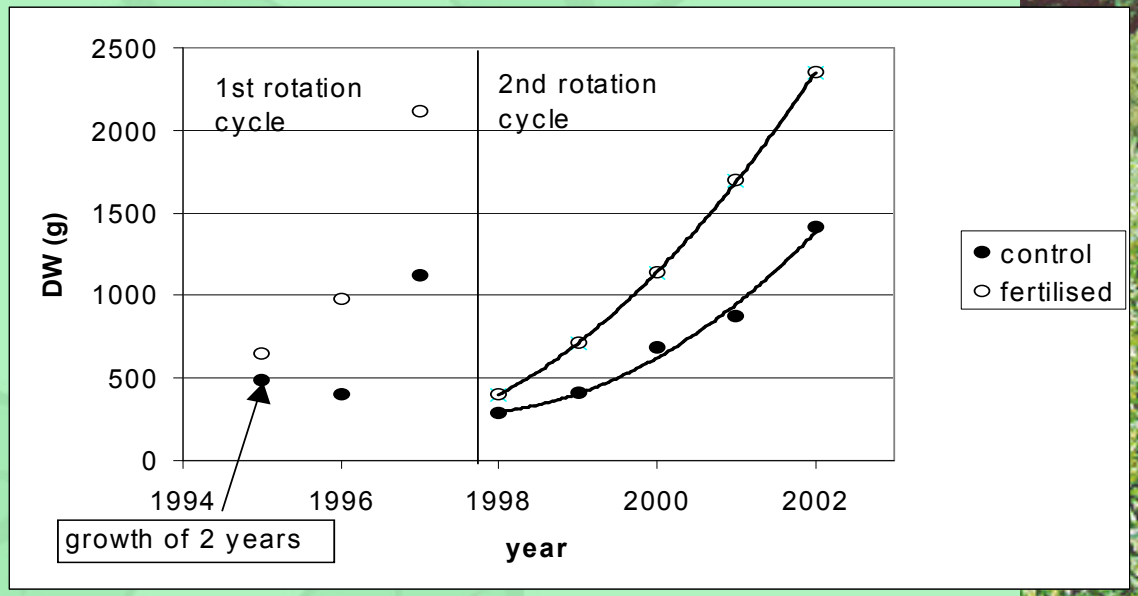


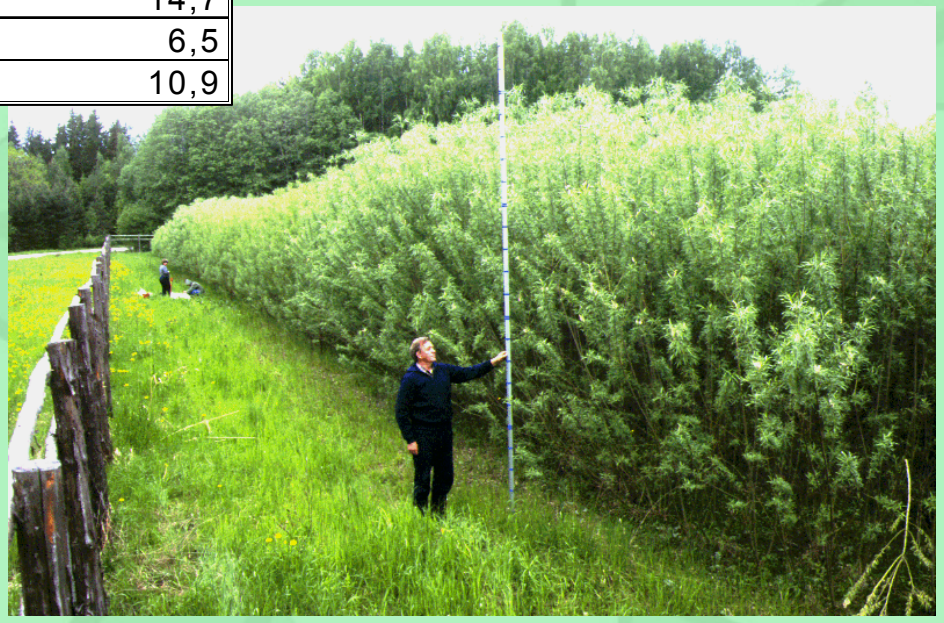
Photo: July 2003, 3rd rotation

3.2. Productivity studies
Saare plantation

Results:
1. Fertilisation doubles growth (mechanism - allocation pattern changes)
2. Stability over 3 rotation periods
3. Clone differences

3.2. Productivity studies
Saare plantation

		Annual production (t ha^{-1})	
		Average of 7 clones	Best clone
1st rotation period	Control	5,2	8,7
	Fertilised	11,0	14,7
2nd rotation period	Control	5,0	6,5
	Fertilised	7,4	10,9



3.3. Waste utilisation
a. Municipal sludge utilisation studies
Nõo plantation

Area: 0.44 ha

Municipal sludge: 6.3 t (d.w.)

applied in May, 2001

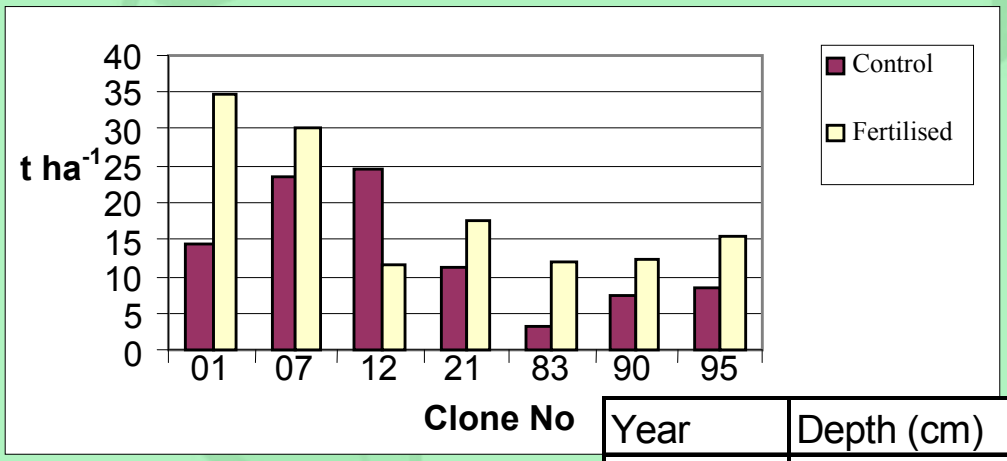
N - 304 kg ha^{-1};

P - 217 kg ha^{-1};

K - 46 kg ha^{-1}

3.3. Waste utilisation

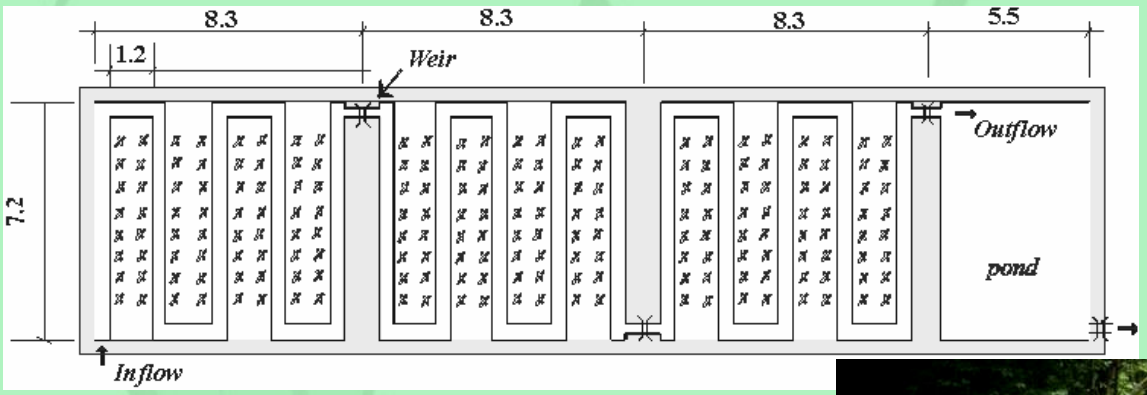
a. Municipal sludge utilisation studies



Year	Depth (cm)	Plot	BOD7 (mgO l^{-1})	N (mg l^{-1})	P (mg l^{-1})
2001	10	control	<3,0	3,9	2,3
		fertilised	4,5	4,8	1,3
	40	control	<3,0	1,7	0,4
		fertilised			0,3
2002	10	control	<3,0	1,3	0,1
		fertilised	<3,0	2,8	2,1
	40	control	<3,0	2,7	0,4
		fertilised	<3,0	2,4	0,5

- Municipal sludge almost doubled shoot productivity
- Sludge application did not cause nutrient leakage to groundwater

3.3. Waste utilisation
b. Wastewater purification
Aarike plantation



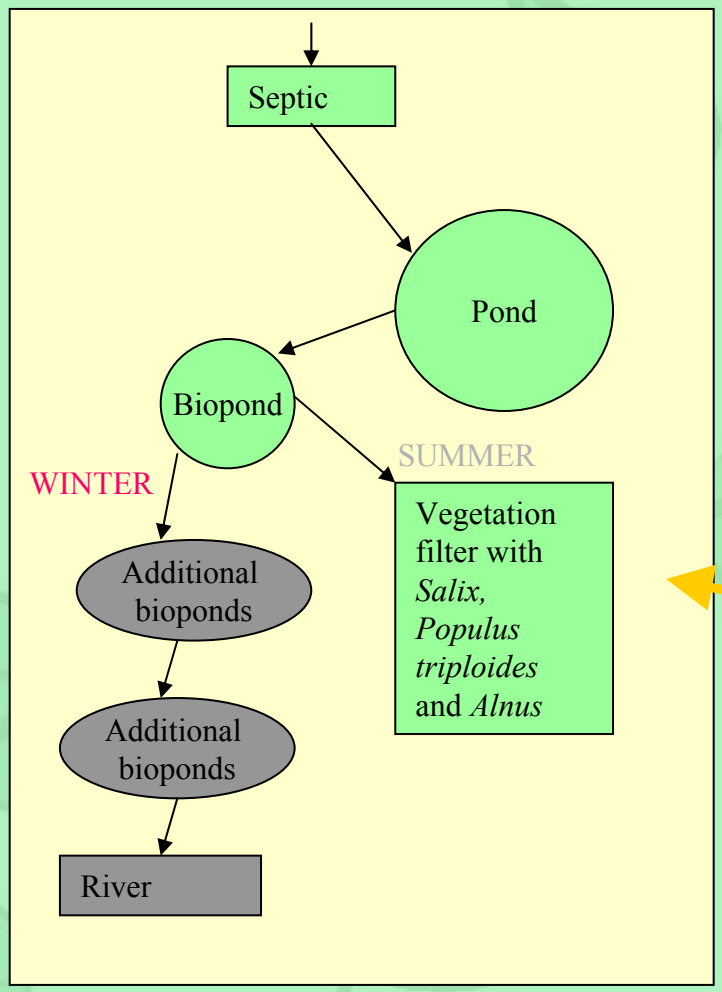
Period	BOD7	total-N	Total-P
1995	60	23	14
1996	72	29	19
1997	60	35	20
1998	60	41	18
1999	88	28	9
Average for the period	75	32	14

3.3. Waste utilisation
b. Wastewater purification
Nutrient removal

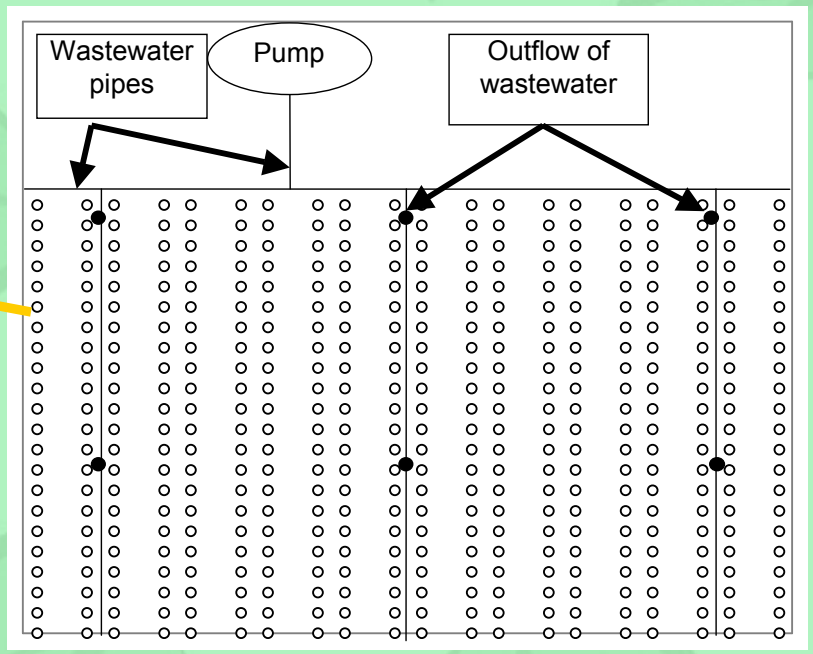
No of plants	205
Average plant shoot growth g y^{-1}	750
Wood productivity (kg y^{-1})	154

	N	P
Purification efficiency (%)	32	14
Annual removal (kg)	35,0	2,1
Concentration in shoots (%)	0,74	0,07
Stored in shoots (kg y^{-1})	1,14	0,11
Removal in biomass (%)	**3**	**5**

3.3. Waste utilisation
C. Wastewater purification & energy production
Kambja prototype



- Ca 1000 PE
- 9.1 ha *Salix* (+5.0 ha control)
- 1.6 ha *Alnus* + *Populus*



3.3. Waste utilisation

C. Wastewater purification & energy production

Kambja prototype

4. Outlook
Ongoing projects

* Ongoing projects

- LIFE ENVIRONMENT demonstration project (2002-2005); 3 Estonian partners (EAU + 2 municipalities)
- EC 6FP CRAFT cooperation research project WACOSYS (2004-2006); Partners from 5 countries
- EC 6FW CRAFT cooperation research project BIOPROS (2005-2007); Partners from ? countries
- Estonian initiative – feasibility study " Analysis of the perspectives for Estonian bioenergy programme" Initiative of two ministries – MoAgr, MoEnv

4.1. LIFE - Sustainable wastewater purification in Estonian small municipalities

Aims

- To establish different prototypes of wastewater purification systems (WWPS) into three rural settlements of Estonia
- To present the innovative sustainable wastewater purification system as one solution for local environmental/energy supply problems in Estonia

Some expected results

- The concentration of nutrients in wastewater discharged to water bodies is lower than threshold imposed by Estonian laws
- Improved knowledge on vegetation filters, ecophysiology of different plant species and purification efficiency
- Disseminated study results enable students to implement the vegetation filter method in the future on larger scale

4.1. WASOSYS - Monitoring and Control System for Wastewater irrigated Energy plantations

Aims

- To develop, test and optimise a monitoring and control system for irrigation and fertilisation of SRP plantations with wastewater
- To guarantee efficient, low cost and sustainable production of combustible biomass products (pellets)
- To reduce wastewater treatment costs for small communities

Some expected results

- Local renewable CO_2 neutral energy sources will be generated
- Surface and groundwater pollution in areas is avoided
- Water resources by reusing wastewater and to close the nutrient loop at local level will be saved
- Rural areas economy will be strengthened
- New markets for renewable energy consumption will be opened

4.1. BIOPROS - Solutions for the safe application of wastewater and sludge for high efficient biomass production in Short-Rotation-Plantations

Aims

- To gain knowledge about the economic, ecological and technical feasibility of SRPs for different local conditions and market requirements
- To transfer it to their SME members (farmers, biomass processors, engineers, decisions makers)

Some expected results

- SRP biomass production throughout Europe and abroad will increase
- Better knowledge about a wide range of SRP aspects will be reached including SRP's best practice and costs as well as related legislation and standards

4.1. Estonian bioenergy feasibility study “Analysis of the perspectives for Estonian bioenergy programme”

KESKKONNAINVESTEERINGUTE K E S K U S

Aims & expected results

- Analysis of legislative background (Estonian, EU, incl. support schemes, environmental constraints)
- Results of the applied research: productivity, perspective cultures
- Analysis of technologies (incl. production, combustion)
- Economical feasibility calculation
- Suggestion of methods for land resource evaluation
- Suggestion of the organisational structure for the commercial production chain

4.2. The next step

Estonian bioenergy programme?

Thank you!

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