

## Perspectives of bioenergy development in Ukraine

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### Biomass Potential in Ukraine

The estimation of the total biomass potential in Ukraine was fulfilled on the base of statistic data [1]. The annual balance of biomass residues in 1997 year is presented in the Table I.

Table I: The annual balance of biomass residues in Ukraine in 1997 year

Type of biomass/ biomass residues	Main crop yield, mill t	Biomass residues coeffi- cient, -	Coeffic. of availabi- lity, -	Biomass residues amount, mill t	LHV, MJ/ kg	Share of biomass available for energy production		Biomass potential for energy produc- tion, mtoe
						%	mill t	
Cereals straw	28.53	1.0	0.85	24.25	15.7	20	4.85	1.82
Maize stems	5.34	1.2	0.7	4.49	13.7	50	2.24	0.74
Sugar beat residues	17.66	0.4	0.4	2.83	13.7	50	1.41	0.46
Sunflower stems	2.31	3.7	0.7	5.97	13.7	50	2.99	0.97
Wood residues	5.4	0.84	0.9	4.1	9.0	71	2.91	0.62
Manure (W90%)	105.4	-	0.62	65.38	22 <sup>*)</sup>	100	65.38	0.92
Landfill gas	1.76	-	1	1.76	15.23	21	0.37	0.13
<b>Total</b>				<b>108.78</b>			<b>19.35</b>	<b>5.66</b>

\*) for biogas

In 1997 the biomass energy potential in Ukraine was about 5.7 mtoe. This corresponds to about 4% of the total primary energy consumption in Ukraine not taking into account MSW potential for combustion and the share of biomass, which is used now by other sectors of economy.

Today the total use of renewable energy in Ukraine (excluding large hydropower) is less than 0.5 % of the total PED. At present there are only some modern wood-fired boilers in operation. Besides, a number of boilers originally designed for coal and oil combustion and later converted for wood combustion are in operation now at timber and wood processing enterprises. As a rule such boilers have fixed grates, batch fuel loading, low efficiency and high emission. There are no straw-fired boilers, combined heat and power (CHP) plants, large anaerobic digesters for manure and food processing wastewater in Ukraine.

At present several demonstration projects in the field of bioenergy are being fulfilled in Ukraine. These plants will be the first modern large-scale bioenergy plants in Ukraine. Firstly it is Dutch-Ukrainian technical assistance project "Energy saving and CO<sub>2</sub> reduction in the timber industry of Ukraine". Steam boiler of 5 MW<sub>th</sub> was installed at the veneer plant "Odek-Ukraine" in Orzhiv, and steam boiler of 1.5 MW<sub>th</sub> was installed at the timber enterprise in Malin. The boilers are equipped with step moving grates and designed for combustion of wood chips, bark and sawdust up to 60% of moisture content. Besides, the Danish-Ukrainian project "Introduction of small-scale straw-fired heat production in Kiev oblast, Ukraine" was done in Ukraine. In frame of the project whole bale straw-fired boiler of 980 kW was installed at village Drozdy, Kiev oblast. In the field of biogas the Dutch-Ukrainian technical assistance project "CO<sub>2</sub> reduction by implementation of a CHP biogas plant in the pig breeding industry" is being realized now. An anaerobic digestion plant of 2000 m<sup>3</sup> reactors volume with CHP of 160 kW<sub>e</sub>+300 kW<sub>th</sub> is under construction at pig-breeding farm on 15000 heads in Elenovka village, Dnepropetrovsk oblast.

## Strategy of Bioenergy Development in Ukraine

The bioenergy strategy of Denmark was accepted as a basis for development of bioenergy strategy for Ukraine. Both countries have rather small territory covered by forest (about 14%) and highly developed agricultural sector that leads to similar structure of biomass potential in these countries.

Table II illustrates the data on equipment, which may be installed in Ukraine according to proposed bioenergy conception. The following specific investment costs were accepted: wood-fired DH plants - 200 \$/kW<sub>th</sub>, wood-fired industrial boilers - 150 \$/kW<sub>th</sub>, wood-fired CHP plants - 2000 \$/kW<sub>e</sub>, small domestic wood-fired boilers - 100 \$/kW<sub>th</sub>, farm and near-by heating straw-fired boilers – 160 \$/kW<sub>th</sub>, straw-fired DH plants - 200 \$/kW<sub>th</sub>, straw-fired CHP plants - 3000 \$/kW<sub>e</sub>, biogas plants - 200 \$/m<sup>3</sup> of digester, landfill gas CHP plants - 1700 \$/kW<sub>e</sub>. It may be noted that these data correspond to foreign equipment. If this equipment is produced in Ukraine, the investment costs may be reduced (possibly twice).

Table II: Bioenergy equipment which may be installed in Ukraine

Type of equipment	Capacity of Ukrainian market, units	Installed capacity		CO <sub>2</sub> reduction <sup>2)</sup> , mill t/year	Operation time, h/year	Fossil fuel replacement, Mtoe/y	Total investments, mill USD
		MW <sub>th</sub>	MW <sub>e</sub>				
Wood-fired DH plants, 1-10 MW <sub>th</sub>	232	812	---	2.44	4400	0.27	162.4
Wood-fired industrial boilers, <5 MW	113	282	---	1.61	8360	0.2	42.3
Wood-fired CHP plants, 1-10 MW <sub>e</sub>	1	10	5	0.1	8360	0.018	10
Domestic wood-fired boilers, <50 kW	12300	369	---	1.17	4400	0.14	36.4
Farm straw-fired boilers, 0.1-1 MW <sub>th</sub>	13000	2600	---	8.24	4400	0.98	416
Straw-fired DH plants, 1-10 MW <sub>th</sub>	700	2450	---	7.76	4400	0.83	490
Straw-fired CHP plants, 1-10 MW <sub>e</sub>	1	10	5	0.1	8360	0.018	45
Large-scale biogas plants	2865 <sup>1)</sup>	702	351	4.5	8360	0.66	573
Landfill gas plants	140	183	92	1.1	8360	0.13	156
<b>TOTAL</b>	<b>30287</b>	<b>7418</b>	<b>453</b>	<b>27.02</b>		<b>3.25</b>	<b>1930</b>

<sup>1)</sup> including 2400 on the cattle farms, 315 – on pig farms, 150 – on poultry plants.

<sup>2)</sup> in comparison with coal combustion

## Conclusions

Ukraine has a good potential of biomass residues available for energy production. Biomass (without MSW for combustion and share of biomass which is used by other sectors of economy) may cover about 4% of total energy demand. The technologies of biomass utilisation are only in the beginning of their development in Ukraine, but they have good perspectives in nearest future.

The feasibility study of these technologies in Ukraine indicates that electricity production from biomass is hardly viable due to low cost of electricity in the market now, but heat production from biomass is competitive and has a good chance for commercialisation. The most promising technologies in Ukraine are as follows: wood-fired DH plants (1-10 MW<sub>th</sub>) and wood-fired industrial boilers (0.1-5 MW<sub>th</sub>) installed at timber and wood processing industry; straw-fired farm and near-by heating boilers (0.1 - 1 MW<sub>th</sub>) and DH plants (1-10 MW<sub>th</sub>); biogas plants installed at large-scale cattle- and pig-breeding farms, poultry farms and food industry enterprises. The most promising development strategy of biomass utilisation technologies in Ukraine, at least in the first stages, seems to be manufacture of corresponding license European and American equipment at the industrial plants of Ukraine.

## REFERENCES

[1] Statistical year-book of Ukraine. 1997. – Kiev: Technika, 1999. – 519 p.