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Development of Bioenergy from Biomass in Ukraine

Abstract. The paper aims to present and assess the current situation of bioenergy production in Ukraine as well as provide insights into its development in the future. It is argued that the great potential of the Ukrainian agrarian sector could ensure not only food needs, but also could become a main source of production and accumulation of bioenergy in agro ecosystems. Under this perspective it can further the increase of energy safety.

Key words: biomass, bioenergy, Ukraine

Introduction

Energy crises prompt European countries to search for alternative sources of renewable energy. Ukraine has good chances and potential for dynamic development of bioenergy. The country has a significant renewable energy potential that can be deployed to enhance the trade balance, create jobs and drive economic activity during a time when the country is facing important economic challenges such as the increased dependence on energy imports and an urgent need to rejuvenate the aging energy capital stock. Deployment of aging energy stocks would also help existing policy goals of reducing the dependency on imported natural gas and help diversify the energy supply.

Objectives and methods

The paper aims to present the current use of biomass for energy production in Ukraine. Attention is paid primarily to the schemes for renewable energy production. Key indicators are presented for concepts of heat and power production from biomass and biogas. Secondary data sources are used, which cover the years 2013-2015.

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Results and discussion

As it is emphasized by the International Renewable Energy Agency [2015] in 2015 the annual technically achievable energy potential of renewable energy sources of Ukraine was 68.6 million tonnes of oil equivalent (Mtoe) per year. This is equivalent to 98 million tonnes of fuel equivalent. This would be sufficient to replace approximately half of the total energy consumption in Ukraine today (Table 1). Ukraine's total wind potential is between 16 GW and 24 GW, with 16 GW considered economically feasible. The most promising regions are the southern and south-western regions, where average annual wind speed at the height of 80 meters exceeds 7.5 meters per second (m/s).

Table 1. Potential of renewable sources in Ukraine

Sources	Annual technically achievable energy potential	
	(TWh/yr)	(Mtoe/yr)
Wind	60	15
Solar	38.2	42
Electricity	5.7	1.4
Thermal	32.5	2.8
Hydro	28.9	7
- *Small*	*20.3*	*4.9*
- *Large*	*8.6*	*2.1*
Bioenergy	178	21.7
Electricity	27	7.2
Thermal	151	14.5
Geothermal	98.6	8.4
Energy of environment	146.3	12.6

Source: International Renewable Energy Agency, Report by REMAP 2030 Renewable Energy Prospects for Ukraine, 2015.

Unfortunately, the pace of development of bioenergy in Ukraine is still significantly behind Europe. Today, the share of biomass in total delivery of primary energy in the country is only 1.2%, and in gross final energy consumption - 1.78%. Every year Ukrainian energy uses about 2 mln./year of biomass of different kinds. The main contribution is wood - its share in total annual consumption of biomass amounts to almost 80% (Table 2). Wood has the highest rate of economically feasible potential - 80%, while other kinds of biomass (excluding sunflower husks), have a much lower figure. The least active (at 1%) is the energy potential of straw cereals and oilseed rape.

As argued by Kulyk [2015] and Geletukha et al. [2013] further development of the biofuel industry in Ukraine is mainly determined by state regulation. There are several state programs that foresee increase of the level of ecological and energy security of Ukraine, decrease of dependence on imported fuels and provision of agricultural sector and transport with competitive biodiesel. However, as mentioned by the Tebodin Ukraine CFI consultants [2013], there is a gap between potential and actual biomass processing for energy in Ukraine, which is explained by a range of problems. The most critical of these

are: unregulated procedure of tariff formation and cross-subsidizing of prices for heat and electricity; lack of modern technologies; difficulties with financing. Additionally, as emphasized by Lakemeyer [2007] and further by Royik [2013] from market perspectives on current price ratios of energy and raw materials, biodiesel and bioethanol production in Ukraine is not yet profitable. Hence, exporting grains and oilseeds to benefit from high demand on international commodity markets until price ratios in Ukraine substantially change seems the better strategy. The applied technology is rather simple and investors would quickly react to changing price ratios.

Table 2. Usage of biomass for generation of energy in Ukraine, 2013

	Annual volume of consumption		Share of total volume of annual of consumption of biomass	Share of economically feasible potential
	Physical units	Thousand tons of fuel equivalent		
Straw of cereals and rape	94 000 tons	33.6	18%	1%
Wood (residential)	5 million m^3	840	45.1%	>90%
Woody biomass (non-residential)	3.2 million tons	763	40.9%	
Sunflower shelling	380 000 tons	146	7.8%	41%
Bioethanol	65 000 tons	42	2.3%	6%
Biodiesel	18 000 tons	16	0.9%	4.8%
Biogas from agricultural waste	22.3 million m^3	10	0.5%	4.4%
Biogas from landfills and municipal solid waste	31.2 million m^3	15	0.8%	8.1%
Total		1864	100%	

Source: Geletukha et al. 2015.

The Law of Ukraine "On Electricity Sector" stipulates some exceptions to which the green tariff cannot be applied. Amongst alternative energy sources these are: blast furnace and coke gases. In the hydro sector, large-scale plans do not qualify. For electricity producers using renewable energy, the green tariff is set at the retail tariff for consumers of second class of voltage as of January 2009 and then multiplied by the green tariff coefficient. After 2014, 2019 and 2024 these will decrease by 10%, 20% and 30% of their basic values respectively (Table 3).

Ukraine has high potential to expand biomass use for energy purposes, primarily for heating. The country has abundant agricultural and forestry waste, and this is a key resource for the development of biomass-based heat and power generation capacity. There are 42.8 million hectares of land that can be used for this, equivalent to 71% of the country's total area. 32.5 million hectares of total agricultural land is arable. Furthermore, Ukraine has one of the most fertile soils in the world, the so-called "chernozem". This helps to maintain sufficient agricultural productivity rates in Ukraine, despite the low use of fertilizers [ProMarketing Ukraine, 2013].

Table 3. Green tariff coefficients for facilities commissioned

Tariff Coefficients	Until March 30, 2013 Inclusive	From April 1, 2013 Until Dec 31, 2014	From Jan 1, 2015 Until Dec 31, 2019	From Jan 1, 2020 Until Dec 31, 2024	From Jan 1, 2025 Until Dec 31, 2029
Wind energy <600 kW	1.20	1.20	1.08	0.96	0.84
Wind energy 600 – 2 000 kW	1.40	1.40	1.26	1.12	0.98
Wind energy > 2 000 kW	2.10	2.10	1.89	1.68	1.47
Biomass	2.30	2.30	2.07	1.84	1.61
Biogas	2.30	2.30	2.07	1.84	1.61
Ground mounted solar	4.80	3.50	3.15	2.80	2.45
Rooftop solar >100k	4.60	3.60	3.24	2.88	2.52
Rooftop solar <100k	4.40	3.0	3.33	2.96	2.59
Micro hydro power	1.20	2.00	1.80	1.60	1.40
Mini hydro power	1.20	1.60	1.44	1.28	1.12
Small hydro power	1.20	1.20	1.08	0.96	0.84

Source: International Renewable Energy Agency, Report by REMAP 2030 Renewable Energy Prospects for Ukraine, 2015.

Table 4. Biomass energy potential in Ukraine, 2013

Biomass type	Technical potential	Share of available energy production (%)	Economic potential
Cereal crops	31 Mt	30	131
Rapeseed straw	4 Mt	40	25
Maize processing waste (footstalks, leaves, heads)	40 Mt	40	129
Sunflower wastes (footstalks, heads)	21 Mt	40	50
Agricultural secondary wastes (sugar-beet pulp, sunflower husk, rise hush)	7 Mt	75	33
Woody biomass	4 Mt	90	52
Energy crops – willow, popular, miscanthus, acacia, alder)	11.5 Mt	90	184
Bioethanol	-	-	30
Biodiesel	-	-	14
Biogas from manure, food residue, sugar waste	1.6 billion m^3	50	29
Landfill gas	0.6 billion m^3	34	8
Sewage	1.0 billion m^3	23	8
Energy crops – biogas from corn silage	3.3 billion m^3	90	108
Peat	-	-	12
TOTAL			813

Source: Geletukha et al. 2013.

According to the estimates from SAEE economically feasible bioenergy potential exceeds 800 PJ/yr – equivalent to a quarter of Ukraine's TFEC. This supply potential consists half from agricultural waste and woody biomass and half from energy crops and biogas (Table 4). The resource potential of woody biomass in Ukraine amounts to 4

megatonnes (Mt) annually. It includes sawmill waste, wood-cutting waste (branches, crowns), firewood and some technical timber, which is currently exported. It is unlikely that this structure will change significantly in the near future. While there is additional forest potential, road transportation of lumber is a limiting factor for heating and power generation. More than 10 Mt of surplus straw remains in farmers' fields every year, and collecting it for use is a challenge. Most agricultural enterprises are not able to gather, bundle and adequately store straw.

Table 5. SWOT analysis of bioenergy in Ukraine

Strengths	Weaknesses
- large potential of biomass (to 25 million т. of ton of conditional fuel) - plenty of wastes and grain-crops; - availability of wood and agro industrial wastes; - high cost of traditional energy sources; - comparatively low competition in industry; - an effective instrument of support is a "green" tariff on electric power (makes 12,39 eurocents/kW·hour) produced from proceeded in energy sources, including from biomass.	- low internal consumption of products of bioenergy; - considerable volumes of products of biomass are exported as raw material (wood, rape, seed of sunflower, soy), but not as finish good of bioenergy or biofuels; - unstable deliveries and absence of long-term supply contracts for raw material for the production of biomass; - an insufficient amount of financial resources and capital investments; - seasonal deficit of supplying raw material for the production of biomass; - high cost of transport and logistic services;
Opportunities	**Threats**
- the high level of foreign market and developing internal market lift demand on bioenergy; - certification of products in accordance with the requirements of EC; - exportation of certified raw material for bioenergy and its finish goods to foreign markets; - support of participants in financing of bioenergy projects; - credit lines, technical help and pilot schemes, financed by international financial organizations; - transmission of knowledge and experience in management of biomass	- lack of legislation and absence of operating government programs and complex aims and priorities; - In Law of Ukraine "On Electroenergy" there is improper ("narrow") determination of term "biomass" (according to which biomass wastes of agriculture, forestry and industries of industry technologically related to them, and products, only are considered); - strong lobby of gas, petroleum and coal industries; - problems with the sale of electric power from biomass on the power market; - growing competition in the international market of solid biofuels (for example, the Russian manufacturers of wood fuel products); - the risks inherent in the agricultural and timber business (bad weather conditions, bad harvest of agricultural crops, a significant change in the price of cereals and raw materials for the production of biomass); - did not establish market conditions for the production and use of biodiesel and bioethanol

Source: authors' own elaboration.

In order to analyze strengths, weaknesses, opportunities and threats of biofuel market we used the SWOT analysis, which remains a classical tool of strategic planning for the development of economic models. On the basis of the SWOT analysis results one can say that the biggest strengths of the biofuel market in Ukraine are the following: potential for biomass energy production; availability of wood and agro-industrial wastes; large quantity of waste and crops; high cost of traditional energy sources.

The weaknesses include: low domestic consumption of bioenergy products; significant quantity of biomass is exported as raw materials; seasonal shortage of raw materials supply for biomass production; high cost of transportation and logistics services; state subsidizing of prices for gas and thermal energy for the population [Cabin 2013]. Regarding the

opportunities and threats of the biofuel market in Ukraine, we have observed imperfect state regulations, especially, the Law of Ukraine "On electricity" containing an incorrect ("narrow") definition of the term "biomass" [Geletukha et al. 2015]. The problems with the sale of electricity from biomass on the energy market; the introduction of additional measures and other means by the EU in order to protect domestic markets (new certification requirements, quotas etc.). However, the possibilities of this market, such as product certification according to EU requirements; export of certified raw material for the bioenergy industry and its end-up-products to foreign markets; support of the participants, financing bioenergy projects; modernization of energy infrastructure and supply of modern equipment; construction and equipment of warehouses for raw material base of biomass and its final products, allow to argue about the upcoming development of the biofuel market in Ukraine.

Conclusions

1. Ukraine has made important progress in recent years in planning the future of its energy system and developing a renewable-energy policy. By the year 2030, the increased use of renewable energy will reduce Ukraine's overall energy system costs.
2. The great potential of the Ukrainian agrarian sector could ensure not only food needs, but also could become a main source of production and accumulation of bioenergy in agro ecosystems. In this perspective it can further the increase of energy safety.

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