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Izabeli Pietkun-Greber i Pawła Ratusznego

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Monograph

# **RENEWABLE ENERGY SOURCES THEORY AND PRACTICE**

## **Vol. II**

Edited by

Izabela Pietkun-Greber and Paweł Ratuszny

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## THE STATE AND PROSPECTS OF DEVELOPMENT OF ALTERNATIVE ENERGY SOURCES IN UKRAINE

### STAN I PERSPEKTYWY ROZWOJU ALTERNATYWNYCH ŹRÓDEŁ ENERGII NA UKRAINIE

**Abstract:** The article deals with the study of state regulation in the field of management and stimulation using of renewable sources in Ukraine. The main mechanisms of support for the use and receipt energy from various renewable and non-traditional sources are highlighted. The content discloses the potential for solar, wind and water energy, the use of biomass as a source of solid, liquid and gaseous fuels.

**Keywords:** renewable energy sources, regulation, stimulation of use, energy efficiency, energy potential

### Introduction

Development of renewable energy is facilitated by means of high level of modern technological progress, gradual reduction in prices and innovations in the schemes of financing, which should be stimulated by the correct state policy of support.

As of November 1, 2016 in Ukraine the installed capacity of objects of renewable energy, to which are given the stimulating «green» tariff, is equal 1421.8 MW, in the current year it was 240.2 MW.

For effective realization of tasks concerning development of the energy of renewable sources in Ukraine first of all it is necessary to create Ukrainian model of development of renewable energy as the separate energy industry - creation of legal and regulatory framework with taking into account the features of development of each of the type of renewable energy sources, determination of the fundamentals of stimulating policy of the state and creation of the legal framework of renewable energy, based on conduction of policy concerning concessions for producers and consumers of energy of renewable sources, determination of financing mechanisms.

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## Statement of basic material

We will characterize the features of national administration in the sphere of energy efficiency [1,2]. During the years of independence in Ukraine was created several government institutions, which were engaged in the regulation of questions of renewable and unconventional energy:

State Committee of Ukraine for Energy Saving (State Energy Saving). It was created on July 26, 1995 by the Decree of the President of Ukraine No. 666/95. The purpose of creation of State Energy Saving - is to provide conduction of uniform state policy in the sphere of energy saving, improvement of operational efficiency, rational use and economical expenditure of fuel and energy resources and implementation of the Law of Ukraine «About Energy Saving». By the decree of the President of Ukraine of April 20, 2005 No. 678/2005 the State Committee of Ukraine for Energy Saving was liquidated, and its functions and fulfillment of its obligations was assigned to the Ministry of Fuel and Energy of Ukraine.

The National Agency of Ukraine for Providing Effective Use of Energy Resources (NAER). It was created on December 31, 2005 by the Decree of the President of Ukraine No. 1900. The mission of NAER - is the conduction of uniform state policy in the sphere of effective use of energy resources and energy saving, provision of increase in the share of alternative fuels in the balance between supply and demand of energy carriers, creation of the state system of monitoring of production, consumption, export and import of energy carriers, improvement of the system of accounting and control of energy resources consumption, provision of functioning of the uniform regulatory system of specific consumption of energy resources in social production. NAER was liquidated according to the order of the Cabinet of Ministers of Ukraine of December 10, 2010 No. 2219 - r.

The State Agency of Ukraine for Energy Efficiency and Energy Saving (State Energy Efficiency). It was created on December 9, 2010 by the Decree of the President of Ukraine No. 1085/2010. The mission of State Energy Efficiency Committee - is the implementation of state policy in the sphere of effective use of fuel and energy resources, energy saving, renewable energy sources and alternative fuels, conduction of the state control in the sphere of effective use of fuel and energy resources, provision of increase in the share of renewable energy sources and alternative fuels in the energy balance of Ukraine.

Ways of realization of the available energy saving potential, as example, we will bring according to provisions of the State target economic program of energy efficiency and development of the sphere of production of energy carriers from renewable energy sources and alternative fuels for 2010 - 2015 (additions, approved by the resolution of the Cabinet of Ukraine of March 1, 2013 No. 243). The purpose of Program was creation of conditions for approach of energy intensity of the gross domestic product (GDP) of Ukraine to the level of developed countries and the standards of the European Union, decrease in the level of GDP energy intensity during the period of validity of the Program by 20% in comparison with 2008 (annually by 3.3%), increase in efficiency of use of energy resources and strengthening of competitiveness of national economy; optimization of the structure of energy balance of country, in which the share of energy carriers received from renewable energy sources and alternative fuels, should have been not less than 10% in 2015, by means of reduction of the share of imported fossil organic types of energy resources, in particular

natural gas, and their replacement with alternative types of energy resources, including secondary, on condition of appropriate financing of the Program.

As a result of legislative activity in the sphere of renewable energy and energy efficiency in Ukraine, as of December 31, 2016, more than 200 acts of national legislation, including 10 Laws of Ukraine, 15 Decrees of the President of Ukraine, 120 Resolution of the Government of Ukraine and other subordinate acts are in force.

Basic laws, which govern the relations in the sphere of renewable energy and energy efficiency in Ukraine are:

- The Law of Ukraine (LU) «About Energy Saving»,
- The Law of Ukraine «About Electricity»,
- The Law of Ukraine «About Alternative Fuels»,
- The Law of Ukraine «About Alternative Energy Sources»,
- The Law of Ukraine «About the Combined Production of Thermal and Electric Energy (Cogeneration) and Use of Dump Energy Potential»,
- The Law of Ukraine «About Gas (Methane) of Coal Fields»,
- Tax Code of Ukraine.

However these acts aren't the documents, which are directly applicable, for their application it is required to adopt subordinate acts of various authorities.

Subordinate regulation concerning construction and work of units on energy generation from renewable energy sources is carried out by authorities of the national level:

- National Energy Regulation Commission of Ukraine (NERC),
- Ministry of Energy and Coal Mining of Ukraine,
- Ministry of Ecology and Natural Resources of Ukraine,
- Ministry of Regional Development, Building and Housing and Communal Services of Ukraine,
- State Agency of Land Resources of Ukraine,
- Local governments for re-zoning.

For now more than 50 national standards of the «Energy saving» group are in force in the sphere of renewable energy and energy efficiency in Ukraine.

Depending on the type of energy of renewable sources and direction of its use in Ukraine are implemented various schemes of their support, which are directed on stimulation of use of energy from renewable sources.

The main legislative act of support, which is directed on stimulation of use of energy from renewable sources in electricity is the Law of Ukraine of 16.10.97 No. 575/97 - BR «About Electricity» (Law No. 575). The standards of this law provided establishment of «green» tariff, by which is bought electric energy, which is produced on electricity generation facilities from alternative energy sources (excluding the blast - furnace gas and coke gas, and with the use of hydro - energy - it is produced only by micro, mini - and small hydroelectric stations). The «green» tariff for economic entities, which produce electric energy from renewable energy sources, is approved by the National Energy Regulation Commission of Ukraine (NERC).

The value of «green» tariff for economic entities, which produce electric energy from renewable energy sources, is established at the level of retail rate for consumers of the second voltage type as of January of 2009, multiplied by the coefficient of «green» tariff.

For economic entities and private households, which produce electric energy with the use of alternative energy sources, the «green» tariff is established till 01.01.2030.

On June 4, 2015 the Verkhovna Rada of Ukraine has supported in general the projected law No. 2010 - d «About introduction of amendments to some laws of Ukraine concerning competitive conditions of production of the electric energy from alternative energy sources». This projected law cancels requirements concerning local component, instead of which the stimulating surcharge to the tariff is introduced in the case of use of domestic equipment, «the green tariff» for big solar electric generating stations decreases twice, the maximum dependable capacity of solar stations of households increases to 30 kW.

In addition to the «green» tariff there are some more instruments of support of the sector of electricity generation from renewable energy sources.

The peculiarities of taxation of profit of the enterprises, which are working in the sphere of renewable energy sources and alternative fuels, are defined by the Tax Code of Ukraine [3], which provides them with the number of benefits:

1. There defined the peculiarities of taxation of the profit of enterprises, which is received in connection with introduction of energy efficient technologies and provides these enterprises with the following tax benefits:
  - Paragraph 158.1 of article 158 of the Tax Code of Ukraine has provided the exemption from taxation of 80% of the profit of enterprises, which is received from the sale of own-produced goods on the customs territory of Ukraine according to the list, established by the Cabinet of Ministers of Ukraine:
    - the equipment, which works at renewable energy sources,
    - materials, raw materials, equipment and accessories, which will be used in energy production from renewable energy sources,
    - the energy efficient equipment and materials, devices, which exploitation provides savings and rational use of fuel and energy resources,
    - the means of measurement, control and management of costs of fuel and energy resources,
    - equipment for production of alternative fuels.

The specified list is approved by the resolution of the Cabinet of Ministers of Ukraine of 28.09.2011 No. 1005.

- Paragraph 158.2 of article 158 of the Tax Code of Ukraine has provided the exemption from taxation of 50% of profit, which is received from accomplishment of energy efficient measures and from implementation of energy efficient projects of the enterprises, which are included in the State Register of Enterprises, institutions, organizations, which conduct development, implementation and use of energy saving measures and energy efficient projects.

To the State Register are added enterprises, which are participants of industry programs on energy efficiency and by results of conducting examination in the order, established by the State Energy Efficiency and which received the decision of such authority about compliance to the criteria of energy efficiency of energy saving measures and energy efficient projects, which are already implemented or are at the stage of development and implementation.

All standards of this article of the Tax Code of Ukraine are in force within five years from the moment of receiving the first profit due to increase in energy efficiency of production. The order of inclusion to the State Register is approved by the order of NAER of 01.04.08 No. 49.

2. The following tax benefits are provided to the enterprises for development of use of renewable energy sources and alternative fuels:
  - Temporarily, for the period of 10 years, since 01.01.2011, there exempted from taxation the profit, which is received from the main activity of the enterprises in electricity sphere (class 40.11 group 40 of Industry Classification System of DC 009:2005), which produce electric energy only from renewable energy sources (subsection 4 of the Section XX of the Tax Code of Ukraine).
  - Temporarily, till 01.01.2020, there exempted from taxation the profit of enterprises, which is received by them from activities on simultaneous production of electric and thermal energy and/or production of thermal energy with the use of biofuel (subsection 4 of the Section XX of the Tax Code of Ukraine).
  - The electric energy, produced from renewable sources, is exempted from payment of duties in the form of surcharge to the operating tariff for electric and thermal energy (item 311.1 of the Tax Code of Ukraine).
  - The tax for the land plots (within the limits and outside the settlements), which are provided for placement of the objects, which produce electric energy from RES, is of 25% of established tax rates (item 276.6 of the Tax Code of Ukraine).
3. For development of bio-energetics the following tax benefits are provided to the enterprises, which activity is connected with biofuels:
  - Temporarily, till 01.01.2020, the profit of producers of biofuel, which is received from biofuel sale, is exempted from the taxation.
  - Temporarily, till 01.01.2020, there exempted from taxation the profit of enterprises, which is received by them from activities on simultaneous production of electric and thermal energy and/or production of thermal energy with the use of biofuel (subsection 4 of the Section XX of the Tax Code of Ukraine).
  - Temporarily, till 01.01.2020, there exempted from taxation the profit of producers of technique, equipment, defined by the article 7 of the Law of Ukraine «About alternative fuels» for production and reconstruction of technical and transport means, including self-propelled agricultural machinery and electric power plants, which consume biological fuel types, received from the sale of specified equipment, which were made on the territory of Ukraine.
4. The benefits for enterprises, which activity is connected with the use of gas (methane) of coal fields.
  - Temporarily, till 01.01.2020, there exempted from taxation the profit of enterprises, which is received by them from economic activities on production and use of gas (methane) of coal fields, which is carried out according to the Law of Ukraine «About gas (methane) of coal fields».
5. Paragraph 197.16 of article 197 of the Tax Code of Ukraine has provided the exemption from taxation of operations on import to the customs territory of Ukraine of energy saving materials, equipment and accessories. The list of such goods

is approved by the resolution of KМУ «Questions of Import of Energy Saving Materials, Equipment and Accessories to the Customs Territory of Ukraine» of 14.05.2008 No. 444.

Also the paragraph 2 of subsection 2 of the section XX «Transitional provisions» of the Tax Code of Ukraine has provided the temporary, till 01.01.2019, exemption from the tax of added value of operations on delivery of technique, equipment, defined by the article 7 of The Law of Ukraine «About Alternative Fuels», on the territory of Ukraine the operations on import by the Ukrainian Classification of Commodities for Foreign Economic Activity, defined by the article 7 of the Law of Ukraine «About Alternative Fuels», technique, equipment, which are used for reconstruction of existing and construction of the new enterprises on production of biofuel and for production and reconstruction of technical and transport means for the purpose of biofuel consumption, if such goods aren't produced and have no analogs in Ukraine and also technical and transport means, including self-propelled agricultural machinery, which work on biofuel, if such goods aren't produced in Ukraine.

The order of import to the customs territory of Ukraine of technique, equipment, technical and transport means, which are used for development of production and provision of consumption of biological fuel types, is approved by the resolution of KМУ of 18.05.2011 No. 581.

Besides the paragraph 15 of subsection 4 of the section XX «Transitional provisions» of the Tax Code of Ukraine has provided the exemption from taxation the profit of producers of biofuel, which is received from the sale of biofuel, the profit of enterprises, which is received by them from activities on simultaneous production of electric and thermal energy and/or production of thermal energy with use of biological fuel types, the profit of producers of technique, equipment, defined by the article 7 of the Law of Ukraine «About Alternative Fuels» for production and reconstruction of technical and transport means, including self-propelled agricultural machinery and electric power plants, which consume biological fuel types, received from the sale of specified technique, equipment, which were made on the territory of Ukraine.

In Ukraine there are tax benefits for the enterprises, which activity is connected with biofuels. Among them only one is directly connected with the sector of production of thermal energy, and others can be related to any sector depending on direction of use of certain type of biofuel. So, temporarily, till до 01.01.2020, they are exempted from the taxation (subsection 4 Section XX of the Tax Code of Ukraine):

- the profit of producers of biofuel, received from biofuel sale,
- the profit of enterprises, received by them from activities on simultaneous production of electric and thermal energy and/or production of thermal energy with the use of biofuel,
- the profit of producers of technique, equipment, defined by the article 7 of the Law of Ukraine «About alternative fuels» (No. 1391 - XIV of 14.01.2000), for production and reconstruction of technical and transport means, including self-propelled agricultural machinery and electric power plants, which consume biofuels, received from the sale of specified technique, equipment, which were made on the territory of Ukraine.

Temporarily, till 01.01.2019, there exempted from payment of value added tax (subsection 2 of the Section XX of the Tax Code of Ukraine) and from payment of duty (the Section XXI of the Customs Code of Ukraine [5]) the operation on:

- deliveries of technique, equipment, defined by the article 7 of the Law of Ukraine «About Alternative Fuels» on the territory of Ukraine;
- import by the codes of Ukrainian Classification of Commodities for Foreign Economic Activity, defined by the article 7 of the Law of Ukraine «About Alternative Fuels», of technique, equipment, which is used for reconstruction of existing and construction of new enterprises on production of biofuel, if such goods aren't produced in Ukraine. In particular, to these types of technique, equipment belong boilers, central heating boilers and the auxiliary equipment for them, gas generators, internal combustion engines, burners, etc.

The order of import of the specified technique, equipment, technical and transport means is defined by the Cabinet of Ministers of Ukraine [5].

It should be noted that in the Tax Code of Ukraine are written some more tax benefits for the enterprises, which activity is connected with the use of equipment, which is working at RES and with implementation of energy efficient projects. These mechanisms of support can be referred to all sectors of bio-energetics (electricity, thermal energy sector, transport) depending on exactly where the activity of specific enterprises is directed.

Operations on import to the customs territory of Ukraine (paragraph 197.16 of the Tax Code of Ukraine) are exempted from the taxation:

- the equipment, which works at RES, the energy saving equipment and materials, equipment, materials for production of alternative fuels or for energy production from RES;
- materials, equipment, accessories, which are used for production of equipment, which is working at RES, materials, raw materials, equipment and accessories, which will be used in production of alternative fuels or energy production from RES;
- the energy saving equipment and materials, devices, which exploitation provides savings and rational use of fuel and energy resources.

The tax benefit can be received if these goods are used by the payer of tax for own production and if identical goods with the similar quality indicators aren't produced in Ukraine. The list of such goods with the indication of codes of Ukrainian Classification of Commodities for Foreign Economic Activity is established by the Cabinet of Ministers of Ukraine [6].

There exempted from the taxation the 80% of the profit of enterprises, which is received from the sale of own-produced goods in Ukraine according to the list, established by the Cabinet of Ministers of Ukraine [7] (paragraph 158.1 of the Tax Code of Ukraine):

- equipment, which works at RES;
- materials, raw materials, equipment and accessories, which will be used in energy production from RES;
- the energy efficient equipment and materials, devices, which exploitation provides savings and rational use of fuel and energy resources;
- equipment for production of alternative fuels.

Among other things the list of these goods includes solid biomass boilers with the efficiency of 80% and above, gas generators on biomass with the efficiency of 85% and above, heat generators on alternative fuels (to which belong biofuels) with the capacity from 3 kW and above with the efficiency of 80% and above, the cogeneration units on biogas from wastes and other types of equipment. The tax benefit is in force within 5 years from the moment of receiving the first profit due to increase in energy efficiency of production.

There exempted from the taxation the 50% of profit, which is received from accomplishment of energy efficient measures and from implementation of energy efficient projects of the enterprises, which are included in the State Register of Enterprises, institutions, organizations, which conduct development, implementation and use of energy efficient measures and energy efficient projects. The register is conducted by the State Energy Efficiency of Ukraine [8]. The tax benefit is in force within 5 years from the moment of receiving the first profit due to increase in energy efficiency of production.

In Ukraine are set goals concerning production and use of biofuel on transport. Till 2013 the goals were recommended, for the next years – obligatory. These goals are recorded in the Law of Ukraine «About Alternative Fuels».

According to this Law, the content of bioethanol in motor gasoline, which is produced and/or realized on the territory of Ukraine, should be: in 2013 - the recommended content was not less than 5%, in 2014 - 2015 - obligatory content was not less than 5%, since 2016 - obligatory content was not less than 7%.

The support tool of development of this sector is the tax benefit for bioethanol as excise goods. According to the Tax Code of Ukraine (Article 229.1.1) the tax is collected at the rate of 0 UAH for 1 liter of 100 percent alcohol from:

- the bioethanol, which is used by enterprises for production of mixed motor gasolines with the content of bioethanol, ethyl tertiary butyl ether, other additives on the basis of bioethanol;
- bioethanol which is used for production of biofuel.

Besides, there exempted from taxation the 80% of profit of enterprises, which is received from the sale of own - produced goods in Ukraine (paragraph 158.1 of the Tax Code of Ukraine) according to the list established by the Cabinet of Ministers of Ukraine (The resolution No. 1005 of 28.09.2011). In particular, this list includes internal combustion engines on the biodiesel, internal combustion engines on biofuel with the content of ethyl alcohol of 85% for transport vehicles.

Thus, the certain schemes of support are already embodied in Ukraine, which are directed to stimulate the use of energy from renewable sources and energy efficiency. But these schemes are quite difficult for understanding and implementation as they are based on significant amount of legislative and subordinate acts. By connecting this problem with rather high initial capital for introduction of the latest technologies we receive the low rate of development of this sector of national energy.

Along with this it should be noted that energy resources of renewable energy sources are practically throughout the entire territory of Ukraine. To the main components of renewable energy of Ukraine belong wind energy, solar energy, small hydropower, bio - energetics, geothermal energy and energy of environment (the use of thermal pumps).

The general annual technically achievable energy potential of renewable energy sources of Ukraine, calculated as the standard fuel, is about 68,9 million tons of nonrenewable equivalent (million tons of n.e.), which is more than 50% of the general energy consumption in Ukraine for now and 30% of the forecasted energy consumption in 2030 [9].

Annual indicators of technically achievable energy potential of the main directions of development of the energy of renewable sources in Ukraine are given in the table 1 [10].

**Table 1.** Potential of renewable energy in Ukraine [10]

No	RES	Annual technically achievable potential	
		bln. kW·hours year	mln. t n. e/year
1	Wind energy	60	15
2	Solar energy, which includes:	38.2	4.2
	- electric	5.7	1.4
	- thermal	32.5	2.8
3	Big hydropower	20.1	4.9
4	Small hydropower	8.6	2.1
5	Bio - energetics, which includes:	178	21.7
	- electric	27	7.21
	- thermal	151	14.49
6	Geothermal energy	97.6	8.4
7	Energy of environment	146.3	12.6
<b>Total volumes of replacement of traditional energy resources</b>		<b>548.8</b>	<b>68.9</b>

The annual technically achievable energy potential of solar energy in Ukraine is equivalent to 4.2 million t of n. e., and its use will allow to save about 5 billion m<sup>3</sup> of natural gas.

The average annual quantity of the total solar radiation, which comes on 1 m<sup>2</sup> of the surface on the territory of Ukraine, is within the range from 1070 kW · h/m<sup>2</sup> in the northern part of Ukraine to 1400 kW·h/m<sup>2</sup> in the Autonomous Republic of Crimea.

Potential of solar energy in Ukraine is rather high for widespread introduction of both the photovoltaic, and heat-power equipment practically in all areas.

The photovoltaic equipment can be operated rather effectively during the whole year, and the term of effective operation of the solar equipment in the southern areas of Ukraine - is 7 months (from April to October), in the northern areas - it is 5 months (from May to September).

It is expedient to focus the transformation of solar energy in electric in the conditions of Ukraine first of all on the use of photovoltaic devices.

Also Ukraine has considerable energy potential of the solid biomass. It is gathered over 50 million t of grain crops annually. Straw and vegetation residues as by - products of agricultural crop production, are in considerable volumes. The annual technically achievable energy potential of solid biomass in Ukraine is equivalent to 18 million t of n. e., and its use provides the opportunity to save annually about 22 billion m<sup>3</sup> of natural gas.

The largest potential of solid biomass is concentrated in the Poltava, Dnipropetrovsk, Vinnytsya and Kirovohrad regions and is more than 1,0 million tons of n. e./year.

By different estimates, on each ton of grain it is possible to receive 1.5 - 2.0 t of straw or the vegetable remains. For the maintenance of cattle and for fertilization of soils are used 50 - 60% of the straw of wheat, barley, rye, and stalks of corn and sunflower remain on the fields after harvesting. Considerable part of straw after harvesting is compressed into bales, briquettes and pellets and is used for heating. At 14 enterprises of the oil industry are burned more than 500 thousand tons of the husks of sunflower and 120 thousand tons of it are granulated.

The percent forest cover of Ukraine is about 16% of its total area. It is annually prepared 16 - 17 million m<sup>3</sup> of commercial timber; the wastes of wood processing are up to 10 million m<sup>3</sup>. For now about 70% of waste wood in the form of sawdust, chips, pellets and briquettes are used as biofuel.

Energy crops - is one more way of receiving the solid biofuel, which has good prospect in Ukraine. A lot of interested businessmen study technologies for cultivation of fast - growing trees, perennial grasses (silver grass, shavnat), annual grasses (sorghum, triticale).

To energy crops also belong traditional agricultural crops, which are grown up for the purpose of production of biodiesel fuel (rapeseed, sunflower), bioethanol (corn, wheat) and biogas (corn).

Ukraine has necessary conditions for production of liquid biofuels, not only by land resources and vegetable potential, but also by the presence of own production capacities. So far today the potential of biomass in Ukraine, suitable for profitable production of liquid biofuels (bioethanol and the biodiesel) gives the grounds to claim the prospectivity of this direction.

The annual technically achievable energy potential of liquid biofuel in Ukraine is equivalent to 1 million tons of n. e. Its use provides the opportunity to save annually about 1.2 billion m<sup>3</sup> of natural gas. The largest potential of liquid biofuel is concentrated in the Vinnytsya and Poltava regions, where it is over 90 thousand tons of n. e./year.

Over the last few years the production of bioethanol fuel is well - established at four distilleries. It is planned in the next three years to involve in production of bioethanol fuel 8 more distilleries.

Effective way of addition and replacement of traditional energy resources is production and use of biogas, which is formed as a result of use of technologies of methane fermentation of vegetable and animal biomass and it consists of methane for 60 - 70%.

Unlike wind energy and solar radiation, biogas can be received irrespective of climatic and weather conditions, and unlike fossil energy sources biogas in Ukraine has very high renewable potential. The annual technically achievable energy potential of biogas in Ukraine is 2,3 million tons of n. e. Its use provides the opportunity to save annually about 2.8 billion m<sup>3</sup> of natural gas. The largest potential of biogas is concentrated in the Dnipropetrovsk, Donetsk and Kyiv regions and is more than 150 thousand tons of n. e./year.

The other sources of biogas are garbage dumps on the solid waste landfills. Also the sources of biogas are waste waters. The sediments of municipal and industrial wastewaters are one of the types of secondary energy resources, which utilization provides the solution

of important environmental, energetic and social problems of the cities, especially megalopolises. The sediments of municipal and industrial wastewaters have large amount of organic substances in their content. But this direction demands considerable capital investments at the use of latest technologies and meanwhile it almost doesn't have any implementation.

National Action Plan on Renewable Energy till 2020 was approved in October of 2014 according to the order of the Cabinet of Ministers of Ukraine No. 902/r.

According to this Plan the general rated capacity of electric stations at RES in 2020 will be 10.9 GW (with large hydroelectric stations), of them - 2.3 GW of photovoltaic stations, 2.28 GW of wind-power stations, 5.5 GW of hydroelectric stations, 0.95 GW of biofuel power plants and 0.02 GW of geothermal stations.

In the sphere of heating and cooling the following indicators are provided: Geothermal energy - 50 thousand tons of n. e., solar energy - 200 thousand tons of n. e., bio - energetics - 5000 thousand tons of n. e., thermal pumps - 600 thousand tons of n. e.

## Conclusions

Stimulation of development of renewable and unconventional energy sources gives an impetus to receipt of capital investments in the segment of energy market, which is new to Ukraine. The greatest progress is made in the field of biogas, because generally in its receiving are engaged the leading agricultural enterprises of Ukraine, which are able to invest considerable sums of money in the innovative projects. Also there are considerable positive changes in direction of receiving the electric energy from the sun.

Along with this it should be noted the difficult and quite complicated system of state regulation of this industry. Also the negative effect on the rates of introduction of renewable sources in Ukraine has considerable price of the latest technologies and the lack of available funds at the average and small business.

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## STAN I PERSPEKTYWY ROZWOJU ALTERNATYWNYCH ŹRÓDEŁ ENERGII NA UKRAINIE

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**Streszczenie:** Przedstawiono wyniki analizy systemu państwowej regulacji oraz wspierania procesów wykorzystania OZE na Ukrainie. Podkreślono główne mechanizmy promocji energii ze źródeł odnawialnych oraz alternatywnych. Oszacowano potencjał energii słonecznej, wiatrowej i wodnej, biomasy jako źródła paliw twardych, płynnych i gazowych.

**Słowa kluczowe:** odnawialne źródła energii, regulacja, stymulacja wykorzystania, efektywność energetyczna, potencjał energetyczny