PROSPECTS FOR RENEWABLE ENERGY IN UKRAINE

Professor Hovorov Pylyp Paramonovich, Dr.Sc.
O. M. Beketov National University of Urban Economy in Kharkiv

Hovorov Vladlen Pylypovich, reseacher worker *O. M. Beketov National University of Urban Economy in Kharkiv*

Kindinova Anastasiya Kostyantynivna, master *O. M. Beketov National University of Urban Economy in Kharkiv*

Abstract

Considered the state and evaluated the prospects for renewable energy in Ukraine. Proposed new technical solutions to improve the energy efficiency of solar energy.

Keywords: renewable energy, energy efficiency, solar energy.

INTRODUCTION

"Energy is the queen of the world, and the entropy is its shadow. Everything on Earth arises and develops through energy, everything collapses and dies with increasing entropy. Energy is the source and measure of the motion of matter and the action of forces, entropy is a measure of their gradual extinction." [1]

Today, mankind has realized that it is time for all the non-renewable chemical (coal, oil, gas), and also nuclear energy sources to be exhausted and we will have to live in a state of dynamic equilibrium, content with continuously renewable sources of energy (RES): solar energy, wind energy, the energy of water movement in rivers, seas and oceans, the thermal energy of the Earth's interior, the energy of plants, etc. By this time, humanity has come very close to, and even entered into it, in parallel with the consumption of organic fuels, today successfully using RES.

EXPOSITION

Modern Ukraine is characterized by a shortage of fuel and energy resources due to a shortage of its own organic fuel resources forced to more than half buy them abroad (Poland, Russia, Turkmenistan, Uzbekistan) in the amount of 60 million tons. (1 kg = 7000 kcal / kg) for a total of $ 7 billion.

Table 1. *General characteristics of fuel resources produced in Ukraine per year*

Own resources	*Required*
Coal - 76,2 million tons (95%)	*~ 100 million tons*
Gas - 18 - 20 billion m^3 / year (3%)	*80 - 100 billion m^3 (10 times more)*
Oil - 4,4 million tons (2%) + condensate	*40 million tons (10 times more)*
Uranium ore (^{235}U) - for 150 years	*enough for 150 years*

The basis of electric power industry in Ukraine is:

1) 21 thermal power plants (TPP) with a total capacity of 29 240 MW

2) 5 nuclear power plants (NPP) with a total capacity of 12,818 MW

3) 4 hydroelectric power stations (HPP) with a total capacity of 3,309 MW

Total capacity of power plants 45 367 MW

Annually in Ukraine, (166 ÷ 200) billion kWh of electric power is generated, that is, about 4000 kW·h per 1 person in year. In the US, this figure is ~ 12 500 per 1 person per

year, that is 3 times more. This requires the emergence of new, including renewable, sources of energy.

The transition of Ukraine RES may be dictated by the following reasons:

a) population growth and increase in energy

consumption per person. In Ukraine, this is 3700 kW·h/ person·year, in the USA 12 600 kW·h/ person·year;

b) increase in harmful emission (sulfuroxide,

CO^2, nitrogen oxide, etc.) - a sharp deterioration in the environment, ozone holes and climate change

(greenhouse effect);

c) depletion of fossil fuels.

The scientific forecast showed that the global crisis can be overcome if we switch to alternative energy while reducing energy consumption.

The potential of Ukraine in RES is:

1) Solar energy - 4,95 million tons (6,2%)

2) Wind power - 24,6 million tons (31,4%)

3) Bioenergy (biogas) - 21,2 million tons of fuel (27,1%)

4) Small hydropower - 2,24 million tons (2,9%)

5) Methane mine deposits, as well as artificial combustible synthetic gases - 13,2 million tons (16,7%)

6) Geothermal heat, oils, alcohols, solid municipal waste - 12 million tons (15,7%)

Total ~ 78,2 million tons (100%)

As can be seen from table 1, renewable energy sources in Ukraine exceed quantitatively non-renewable sources, but the main problem arises how to convert them into the required type of energy (electric, thermal and others). The calculations show that in Ukraine for all types the share of unconventional energy is 723 · 1012 kW hours per year! This speaks in favor of wider use of RES.

Almost all developed countries follow this path. According to IEC [2], the installed capacity of power plants using unconventional and renewable energy sources is 33 million kW, which is 1.04% of the total installed capacity of all power plants in the world (3,180 million kW). In the US, the share of such power plants is 2,32%, in Brazil - 3%, Denmark - 7,7%, Germany - 2,8%, Italy - 1,2%, Spain - 1%, Japan - 0,4% and The Philippines - 17% of the total installed capacity.

Energy conservation issues are also intensified. For example, former President of the United States Bill Clinton is proud that during his reign in the United States, the environmental and energy program "Million solar roofs" was proclaimed. According to the program, photovoltaic and thermal collectors were installed on the roofs of one million municipal and private houses to use solar energy (heating water and generating electricity). Similar programs were taken by Germany, Denmark, Sweden, Austria, the Netherlands, Japan and other countries. There was also a wide application of heat pumps. In general, up to 20% of the energy of the sun can be used for people's needs (hot water, heating, drying agricultural products, desalination, etc.).

Another example from the field of bioenergetics. When there was a delegation from Austria in Kharkov, it demonstrated success in bioenergy˜ obtaining biogas from Sudanese grass in methane tanks. In one of the farms in the country, Sudan grass is grown on 35 hectares, and the biomass is processed into methane from it. As a result, 500 000 m^3 of biogas is used in mini-electric power plants to produce 1 000 000 kW·h / year of electricity.

In Ukraine, a high yield yields Jerusalem artichoke, and in combination with agricultural waste in the amount of 350-400 million tons per year, in methane thanks can be obtained:

a) gas-115 billion m3

b) motor and food alcohols - 14 million tons

c) charcoal (coke) - 40 million tons

d) oil products - 10.5 million tons

At modern prices is $ 21.3 billion, that is, you can still earn money. In addition, the accompanying effect will be the improvement of the ecological situation in the region.

Frederic Joliot-Curie also said that "It is not so much atomic energy as mass synthesis (photosynthesis) of molecules analogous to chlorophyll that will make a genuine revolution in the world's energy industry". It is known that due to natural photosynthesis there is life on

Earth, there is a concentration of energy and entropy. This gives mankind 80 billion tons of organic substances per year, which is ten times greater than all the organic fuel produced during this time.

Prospects for the development and practical use of renewable energy are associated with two global problems: environmental and energy. These problems are complex, associated with a number of factors: scientific and technical, legal, organizational and economic. Determining the development of appropriate approaches and concepts.

The analysis shows that the fuel and energy balance has significantly changed on the planet: the specific weight of oil is 44%, natural gas 18%, coal 35%. According to experts, all of the organic fuel at the level of its use in 2005 will last for about 150 years. It is expected that up to 2050 90% of all known world oil and gas reserves will be spent. The approximate forecast is as follows: for oil reserves 30 years, gas 25 years, coal 700 years, transuranium 150 years. Environmental damage caused by the use of non-renewable organic energy carriers (coal, oil, fuel oil) and nuclear fuel, their rapid depletion require widespread introduction of generation of heat and electricity based on unconventional clean energy sources, primarily renewable ones.

Renewable energy sources (RES) are those reserves that will be replenished in a natural way, first of all, due to the flow of energy of solar radiation to the surface of the Earth. In the foreseeable future, they (solar energy itself and its derivatives: wind energy, plant biomass, flow waters, etc.) are practically inexhaustible. Therefore, the whole world energy industry is developing in the direction of their use. Countries such as Germany, the USA, Spain, Sweden, Denmark and Japan plan to increase the share of renewable energy in the general energy balance to 20-50% in the first half of the 21st century (see Table 2).

Table 2. The development of thermal and electrical energy from RES in the EU countries

Type of renewable energy sources	*Energy production*				*Total capital expenditures in 1997 - 2010, billion $*	*Reduction of CO^2 emissions up to 2010, mln t / year*
	1995 year		*2010 year*			
	mln. t. n. e.	*%*	*mln. t. n. e.*	*%*		
Wind power	*0,35*	*0,5*	*6,9*		*34,56*	*72*
Hydropower engineering	*26,4*	*35,5*	*30,55*	*16,8*	*17,16*	*48*
Photovoltaic power engineering	*0,002*	*0,003*	*0,26*	*0,1*	*10,8*	*3*
Biomass	*44,8*	*60,2*	*135*	*74,2*	*100,8*	*255*
Geothermal power engineering	*2,5*	*3,4*	*5,2*	*2,9*	*6*	*5*
Solar thermal collectors	*0,26*	*0,4*	*4*	*2,2*	*28,8*	*19*
Total	*74,3*	*100*	*182*	*100*	*198,12*	*40*

The European Community plans to double the part of the energy generated by renewable sources (wind, solar, biomass, hydropower, etc.) until 2010, from 6% to 12% in the total energy supply. Such figures are also a necessary condition for Ukraine to join the EU. The development of renewable energy in Germany is impressive, where only 30 000 people are employed in solar energy, and the annual turnover of funds is 2 billion euros. A similar situation exists in Denmark, Spain, Sweden, Finland, and Austria.

At present, despite the existing economic difficulties of the transition period, Ukraine has

ranked first among the CIS countries in terms of the level of development of RES. There are all grounds for optimistic forecasts of its further development (Table 3).

Table 3. *Contribution of various renewable energy sources to energy production in Ukraine* **(2001)**

Large hydropower engineering	*78,8%*	*Wind power*	*0,2%*
Bioenergetics	*17,79%*	*Geothermal power engineering*	*0,07%*
Small hydropower engineering	*3,1%*	*Solar thermal collectors*	*0,04%*
Total 100%			

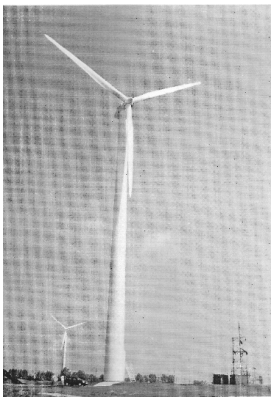

Fig. 1. *Belgian wind turbines T-600 at Novoazovskaya wind farm (Ukraine)*

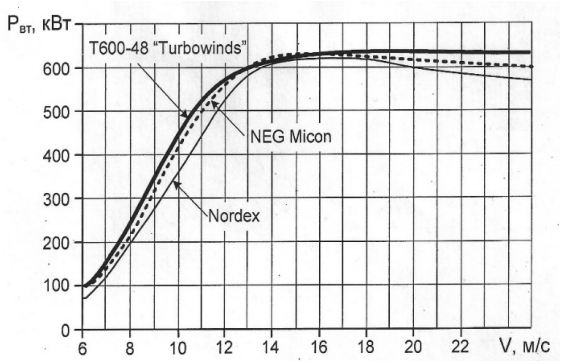

Fig. 2. *Power characteristics of various wind turbines*

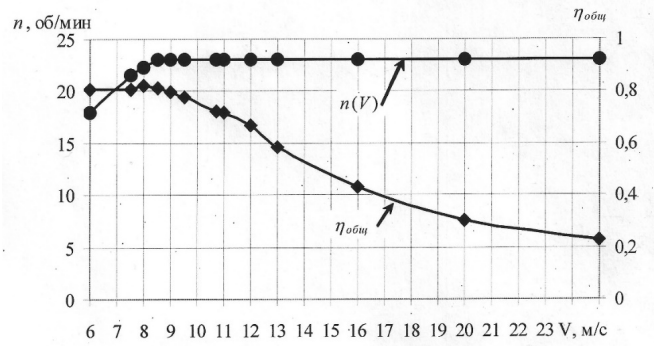

Fig. 3. *Dependence of rotation speed and efficiency wind turbines T600-48 "Turbowinds" from the wind speed*

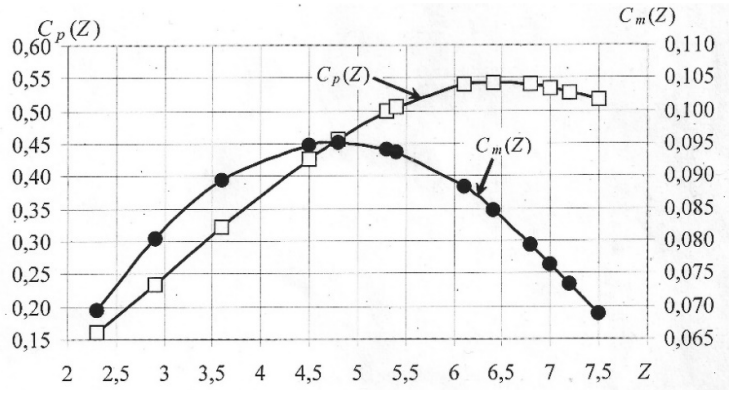

Fig. 4. *Dimensionless characteristics of the wind turbine T600-48*

CONCLUSION

Photovoltaic installations are finding increasing practical application as an electric power source for small and medium-sized consumers requiring autonomous power supply. In some cases, they are connected to electrical networks.

The efficiency of photoconverters made of polycrystalline, amorphous and monocrystalline silicon is already 20%. In Germany, a 5-megawatt FES is operated, which is included in a single state electricity generation system. In Fig. 7 and 8 show the structure of the solar panel and a typical current-voltage characteristic. Fig. 9 show Schematic diagram of an aerostatic photoelectronic (photovoltaic) installation.

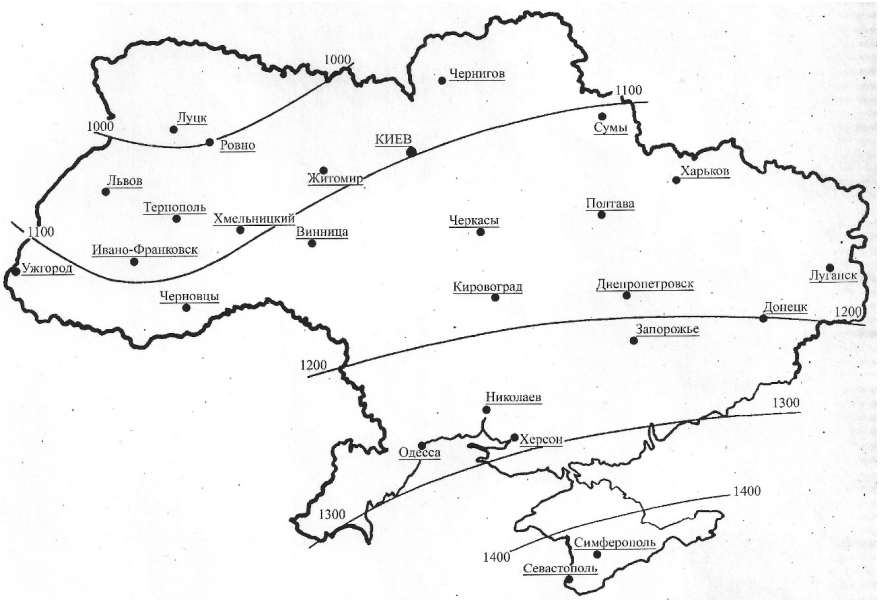

Fig. 5. *Total solar radiation (kW h / m2),*
coming to the terrestrial surface of the territory of Ukraine:
Chernihiv region - 1080; Sumy region - 1110; Volyn region - 980;
Kiev region - 1110; Khmelnitsky region - 1030; Poltava region - 1140;
Donetsk region - 1180; Transcarpathian region - 1160; Odessa region - 1280;
Kherson region - 1280; Crimea - 1450

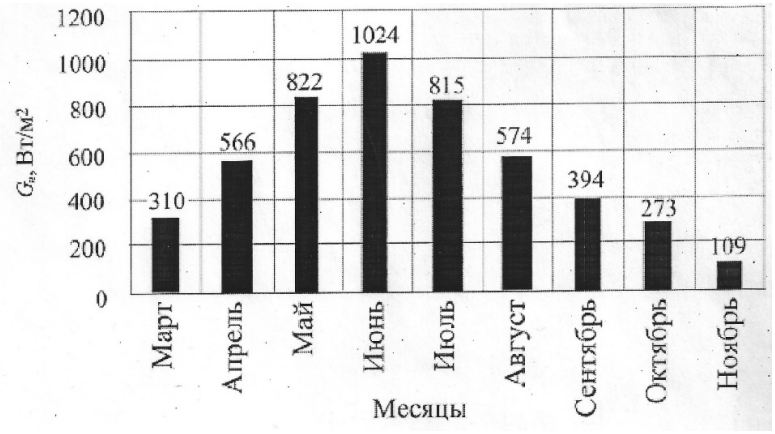

Fig. 6. *Diagram of solar radiation intake in the spring-autumn period (Crimea, Ukraine)*

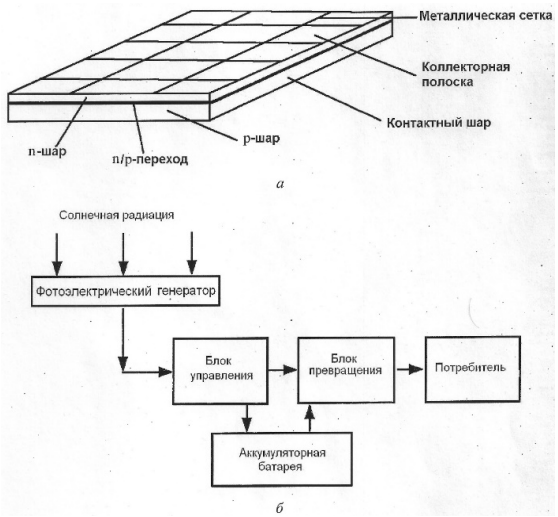

Fig. 7. *Diagram of a silicon photomodule (a) and a block diagram of control (b)*

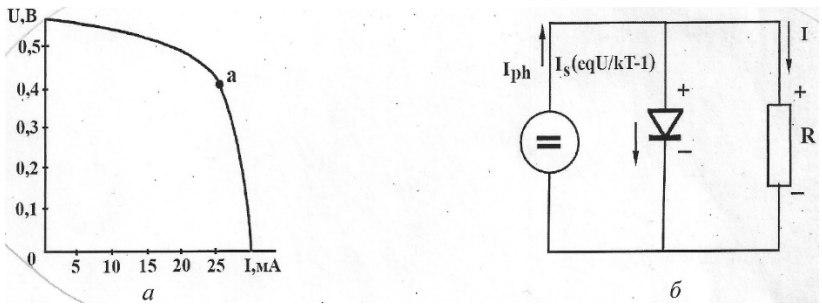

Fig. 8. *A typical I-V characteristic (a) and a calculated current-voltage characteristic (b) solar cell*

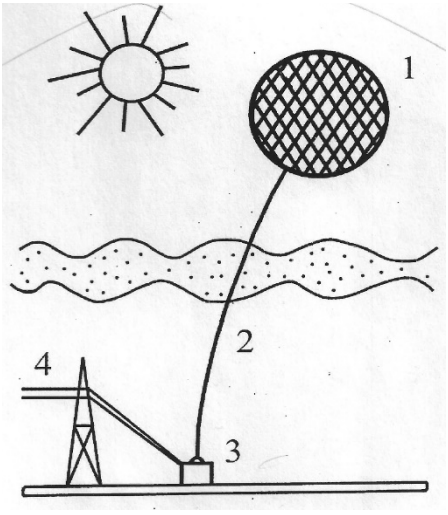

Fig. 9. *Schematic diagram of an aerostatic photoelectronic installation:*
1 - shell with a photoelectric layer; 2 - electric cable; 3 - transformer; 4 - power line

NOTES

[1] - Auerbach F. The Queen of the World and its shadow. Energy and entropy.

[2] - International Electrotechnical Commission.

REFERENCE

[1] Krivtsov V.S., Oleynikov A.M., Yakovlev A.I., Inexhaustible energy. Book 1. Wind power generators. Kharkov: KNAU, 2003. 400 p.
[2] Yakovlev A.I., Fedorenko G.M., From fuel cells in space to powerful sources of thermal and electrical energy on Earth. K., Energy News, №12, 2001. p. 57-63.