ПРОГРЕСС В НЕТРАДИЦИОННОЙ ЭНЕРГЕТИКЕ

Д.С. Стребков

Аннотация. XX век был последним периодом дешевой энергии. Эра дешевой энергии закончилась, и нам нужны новые энергетические технологии, чтобы обеспечить будущее устойчивое развитие. Цель статьи - найти экономичные и надежные, возобновляемые и экологически чистые источники энергии для будущего энергетики. Представлены передовые тенденции развития будущей энергетики. Обсуждается прогноз для развития электро- и теплоэнергетики в 21 веке.

Ключевые слова: бестопливная энергетика, возобновляемая энергия, глобальная солнечная энергетическая система, добыча энергии из органических отходов, будущее осветительной системы, резонансные электрические энергосистемы, солнечное образование

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RENEWABLE ENERGY SOURCES AND THE PROBLEM OF ENVIRONMENTAL PROTECTION

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Annotation. *In this paper presents research results the environmental assessment of emissions of harmful substances into the air from burning fuel for electricity production process power plants RES. It is established that during the production of renewable energy systems pollute the environment. For general environmental assessment must take into account the environmental impact of power plants with the RES on the environment at all stages in the process of their production, use and disposal.*

Key words: renewable energy sources, environment, negative impact, ecologic and economic aspects, method of exergy optimization, exergy balance

Purpose of research - assess the impact alternative energy sources on the environment by use method of exergy optimization.

Material and methods. Renewable technologies are considered as clean sources of energy and optimal use of these resources minimize environmental impacts, produce minimum secondary wastes and are sustainable based on current and future economic and social societal needs [1]. But these energy sources are not totally environmentally friendly. The negative impact of renewable energy on the environment manifests itself in a wide range of environmental factors, for example: contamination with harmful substances, changing the physical parameters of the environment, impact on living organisms, etc [2].

Negative factors from using renewable energy sours and their impact on the ecosystem can be represented by next classification (Fig. 1).

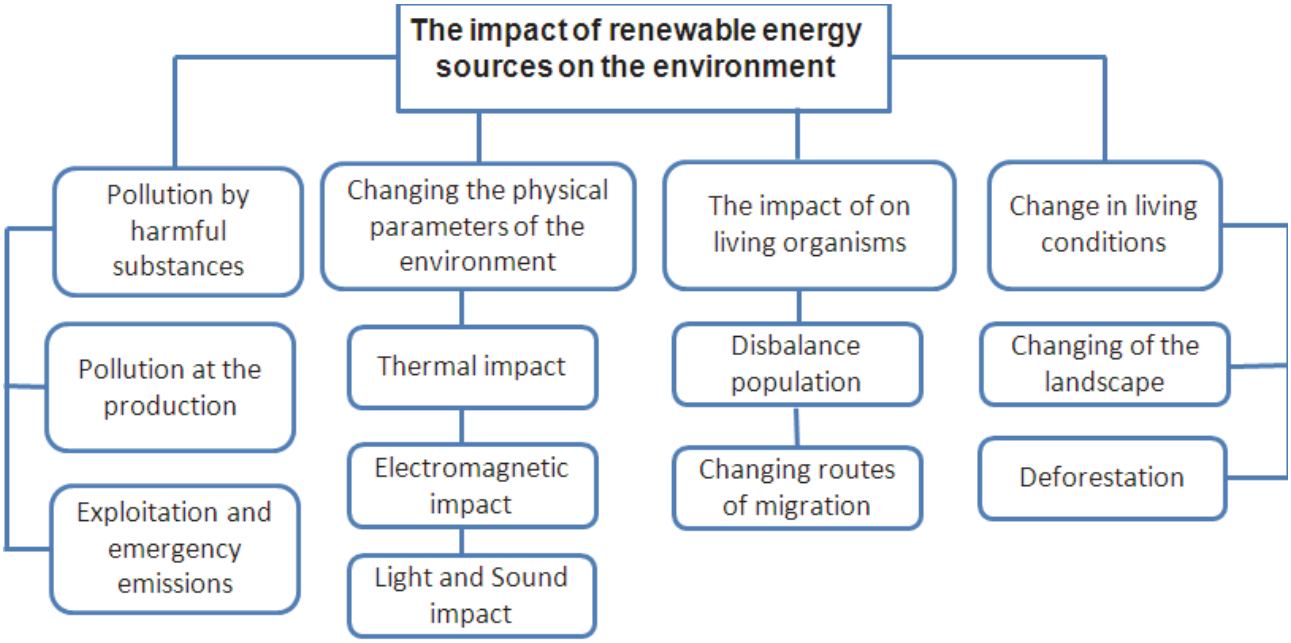

Fig. 1. Classification of the impact of installations on the basis of renewable energy sources on the environment

Due to the low density of the flow of energy (kWh/m^2), installation with renewable sources occupy large areas. In the Table 1 presents data of the production of electricity in recalculation per square meter surface, and the area necessary to generate 1 kWh of electricity annually. For comparison given data on the production of electricity in thermal and nuclear power plants.

Analysis has shown that to produce 1 kWh of solar energy is necessary area, which 200 times exceeds area required to produce the same amount of energy in thermal power plants.

For the environmental assessment of energy consumption in the process of production of renewable energy power plants were calculated emissions of harmful substances into the atmosphere from fossil fuel combustion. The structure of consumption of fuel for thermal power plants is: gas - 55%, coal - 34%, fuel oil - 5%.

In the process of combustion of fuel (coal, oil, gas) form CO, CO2, SO2, CH4, dust. Emissions of harmful substances in the production of electric energy for different types of renewable energy are shown in Fig.2.

Table 1

№	Type of installation	Generation of electricity, kWh/m^2	Occupied area, m^2/kWh
1	Wind power stations	12	0,083
2	Solar power stations	30	0,033
3	Biogas plants	100	0,010
4	Thermal power stations	6000	0,000167
5	Nuclear power plants	15000	0,000067

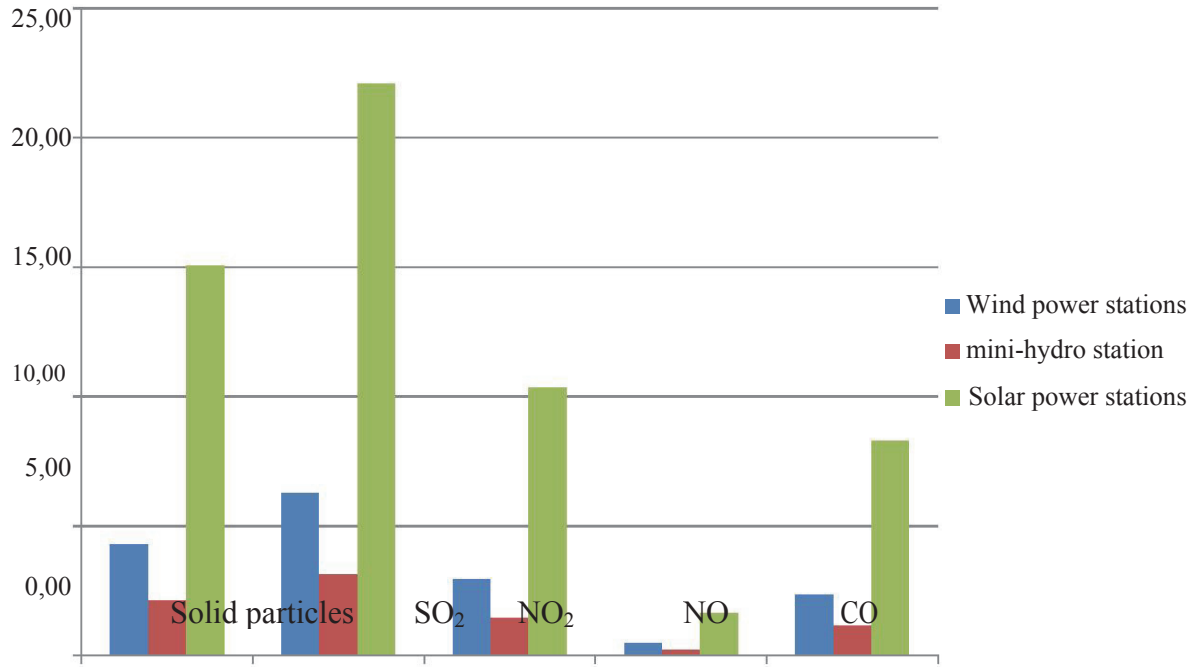

Fig.2. Emission of harmful substances in the production of renewable energy installations

Ecological and economic aspects of renewable energy in power systems can be analyzed by using the method of exergy optimization [3].

In terms of exergy, the ecological factor - is the maximum useful work done by the system over the environment.

The concept of exergy optimization accepted to use the following notation.

Exergy of all flows which enter into the element of the system or in the system in general, including the system of energy flow (eg, sunlight) is called the exergy fuel E_F. Exergy of all flows which coming out of the element (of the system), including the exergy flow of energy produced in the element (system) is called exergy product E_P.

$$E_F = E_P + E_L + E_D, \qquad (1)$$

where E_L – loss of exergy; E_D – exergy destruction.

In this case we have

$$E_F = \int_0^{\tau_0} E_F \exp(-\lambda\tau)\,dt \approx E_F\left[1-\exp(-\lambda\tau_э)\right] = E_F(\tau_э)\frac{\tau_\lambda}{\tau_э}\left[1-\exp\left(\frac{\tau_э}{\tau_\lambda}\right)\right], \qquad (2)$$

where $\tau_э$ – standard time discount, otherwise the degree of discounting λ; $\tau_э$ – full lifetime of the system.

In thermodynamics value λ can be measured in the direction of reduction (depletion of natural resources) and upward (appearance of new resources). In the thermal ecology value λ changes as follows:

- λ always reducs with using traditional and non-renewable energy sources, because natural resources are exhaustible;
- λ increases with the use of renewable energy sources.

According to the principles exergy optimization, can assume that losses due to ecological factor are proportional output exergy flows from the system.

$$\Delta S_{ср} + \Delta S_{хол} + \Delta S_{гор} = \sum \Delta S, \qquad (3)$$

where $\Delta S_{ср}$ – an increase of the entropy the environment as a result of heat input; $\Delta S_{хол}$ – the decrease in entropy of the cooling element; $\Delta S_{гор}$ – decrease in entropy of the heating element; ΔS – the total entropy change according to the temperature level at which the process.

The degree of ecological factor is determined by two factors: heat flow to the environment in which equation (3) is crucial and CO2 emissions can be evaluated by an appropriate thermal equivalent.

Conclusions

The research results shown:

1. In the production process of all renewable energy installations occur environmental pollution.
2. The minimum level of contamination occurs for mini-hydro station, and solar power are not environmentally friendly.
3. The method of exergy optimization allows with sufficient accuracy to determine the degree of influence of renewable energy, including the assessment of damage caused by harmful emissions on the environment.

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ВОЗОБНОВЛЯЕМЫЕ ИСТОЧНИКИ ЭНЕРГИИ И ПРОБЛЕМА ЗАЩИТЫ ОКРУЖАЮЩЕЙ СРЕДЫ

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Аннотация. Представлены результаты исследования экологической оценки выбросов вредных веществ в атмосферный воздух от сжигания топлива для производства электроэнергии энергетических установок с ВИЭ. Установлено, что процесс производства возобновляемых источников энергии загрязняет окружающую среду. Для общей экологической оценки необходимо учитывать экологическое воздействие энергоустановок с ВИЭ на окружающую среду на всех этапах: в процессе их производства, эксплуатации и утилизации.

Ключевые слова: возобновляемые источники энергии, окружающая среда, негативное влияние, экологические и экономические аспекты, эксергетический метод оптимизации, эксергетический баланс

ВІДНОВЛЮВАНІ ДЖЕРЕЛА ЕНЕРГІЇ ТА ПРОБЛЕМА ЗАХИСТУ НАВКОЛИШНЬОГО СЕРЕДОВИЩА

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Анотація. Представлені результати дослідження екологічної оцінки викидів шкідливих речовин в атмосферне повітря від спалювання палива для виробництва електроенергії в енергетичних установках з ВДЕ. Встановлено, що процес виробництва поновлюваних джерел енергії забруднює навколишнє середовище. Для загальної екологічної оцінки необхідно враховувати екологічний вплив енергоустановок з ВДЕ на навколишнє середовище на всіх етапах: у процесі їх виробництва, експлуатації та утилізації.

Ключові слова: відновлювані джерела енергії, навколишнє середовище, негативний вплив, екологічні та економічні аспекти, ексергетичний метод оптимізації