ORES
Научно-практический электронный журнал
Оригинальные исследования (ОРИС), *ISSN 2222-0402*
www.ores.su
original-research.ru

УДК 620.92

ЭКОНОМИЧЕСКАЯ ЦЕЛЕСООБРАЗНОСТЬ ИСПОЛЬЗОВАНИЯ СОЛНЕЧНЫХ ЭЛЕКТРОСТАНЦИЙ В РЕАЛИЯХ США

Лашина Екатерина Николаевна
Старший преподаватель кафедры иностранных языков Санкт-Петербургского Государственного Университета Промышленных Технологий и Дизайна
Высшая Школа Технологии и Энергетики
Санкт-Петербург, ул. Ивана Черных, 4
E-mail: lashinapiter@gmail.com

Сабзалыев Самир Асиф оглы
Студент кафедры АЭиЭ Санкт-Петербургского Государственного Университета Промышленных Технологий и Дизайна
Высшая Школа Технологии и Энергетики
Санкт-Петербург, ул. Ивана Черных, 4
E-mail: Samir.sabzalyev@mail.ru

Аннотация

В данной статье проанализирована целесообразность использования солнечной энергии в энергетическом комплексе Соединенных Штатов Америки (США) с точки зрения экономики. В ходе работы определены основные проблемы и перспективы энергопотребления и энергосбережения в стране. С учетом проделанного анализа сделан вывод для принятия решения о переходе к использованию и применению солнечных электростанций (СЭС) в США.

Ключевые слова: солнечная энергия, солнечные электростанции, СЭС, энергоэффективность, энергоресурсы.

ECONOMIC FEASIBILITY OF USING SOLAR POWER PLANTS IN THE REALITIES OF THE UNITED STATES

Ekaterina N. Lashina
Senior Lecturer of the Department of Foreign Languages, St. Petersburg State University of Industrial Technology and Design
Higher School of Technology and Energy
St. Petersburg, Ivan Chernykh Street, 4
E- mail: lashinapiter@gmail.com

Samir Asif ogly Sabzalyev
Student of the Department of AEE of St. Petersburg State University of Industrial Technology and Design
Higher School of Technology and Energy
St. Petersburg, Ivan Chernykh Street, 4
E- mail: Samir.sabzalyev@mail.ru

ABSTRACT

This article analyzes the feasibility of using solar energy in the energy complex of the United States of America (USA) in terms of economics. The work identifies the main problems and prospects for energy consumption and energy conservation in the country. Based on the analysis, the conclusion has been drawn to make a decision on the transition to the using and applying of solar power plants (SPP) in the United States.

Keywords: solar energy, solar power plants, SPP, energy efficiency, energy resources.

It is difficult to imagine the further development of countries without increasing the rate of energy consumption. However, this trend can lead to environmental destruction and seriously affect the lives of people. One of the solutions that can improve the situation is the wider use of non-traditional energy sources. Scientific communities are making technological breakthroughs in proven and innovative technologies. The governments of many countries are investing heavily in their research, developing alternative energy and transferring production facilities to non-traditional sources. So, it is already necessary to think about the gradual introduction of alternative energy sources into modern life at this stage of the development of society.

Humanity in the XXI century is not threatened by a global shortage of energy resources yet, provided that the planned strategies for energy conservation and energy substitution with alternative sources are observed. In terms of energy supply, the main problem will not be the lack of energy resources, but the lack of investment in their search and production. It is also necessary to remember about the negative impact on the natural environment of the techno genic impact from the enterprises of the fuel and energy complex. Care should be taken to reduce damage to the environment, both by increasing the efficiency of consumption of all types of resources, and by increasing the environmental cleanliness of technologies. Unfortunately, for the coming decades, neither new energy sources nor fundamentally new methods of generating electricity and heat are seen. The most probable scenario seems to be for the development of the energy sector based on the use of all or at least most of the energy resources already known today and the most advanced technologies for converting them into electrical and thermal energy.

However, scientists insist that the use of hydrocarbons should be abandoned. The main source of energy should be the sun, wind and other alternative and renewable energy sources. Nowadays generation based on solar power plants (SPP) is already becoming competitive, although more recently in U.S., due to the low price of electricity, it was difficult for facilities based on renewable energy sources (RES) to compete with traditional hydrocarbon sources. In addition, there is a constant decrease in prices for installations of non-traditional energy sources in the world. For example, solar energy alone becomes 15% cheaper every year. In the United States of America, this factor is not so obvious, since its own mass production has not yet been established.

Recently, from a variety of tribunes, the media have been talking about the need to switch to renewable energy sources. However, one should not forget that the efficiency of applying various non-traditional types of energy depends on the intensity of the energy source [1]. A specific example should be focused attention, namely, the use and application of SPP.

The sun is an inexhaustible source of energy, ultraviolet and thermal radiation. Despite the low efficiency of radiant energy, solar energy has been gaining momentum in development in recent years. The United States did a lot of early research into concentrated solar energy. Solar energy in the United States includes municipal SPPs as well as local distributed generation, mainly from rooftop photovoltaic installations (Figure 1).

Figure 1. *An example of local generation distribution*

As of the end of 2019, the United States had more than 71.3 GW of PV installed capacity. Growth of solar-powered electricity production in U.S. has broken major records last year, accounting for nearly 40% of all new generating capacity. And total installed photovoltaic (PV) capacity is expected to more than double in the next five years, according to an annual report released today by the Solar Industry Association and Wood Mackenzie, a global energy research and consulting firm. Over the same period of time, total solar generation, including estimated small-scale photovoltaic generation, was 96.1 TWh, accounting for 2.30% of total electricity in U.S. [2].

The share of electricity in the United States obtained from renewable sources, including solar energy, increased from 0.1% to 10%. According to forecasts, by 2030 these sources will be able to provide up to 25% of energy in the country [3].

However, the United States, as a whole, does not have great achievements in this direction yet. Compared to traditional energy sources, the development of alternative energy is insignificant. Nevertheless, SPPs are used practically throughout the United States. As a rule, these are spot projects, not large-scale ones.

These projects are most often used in hard-to-reach areas and isolated areas where there is no centralized power generation. In the United States, a huge number of people live in regions with decentralized and autonomous energy supply. Therefore, the construction of SPPs should be in demand in these places. More environmentally friendly sources could create the independence of districts from distant networks, as well as establish trouble-free power supply (Figure 2) [4].

Figure 2. *An example of SPP in hard-to-reach areas and isolated areas. Boulder, Colorado, USA. A small 1 MW plant supplies electricity to waste water treatment plants*

A positive example of solar energy use is a SPP located in Arlington, Maricopa County, Arizona, owned by Sempra Generation. The Mesquite Solar project is a 400-megawatt photovoltaic power plant. Texas has become a gold mine for solar energy, and now claims to be home to the largest US photovoltaic system, which is still under development. The Misae 2 facility, which will be built in two phases, with a total capacity of 692 MW, is due for completion in 2021 [5].

Unfortunately, SPPs have a significant drawback - unstable power generation, which has to be supplemented with traditional generation. During those periods of time when the sun does not shine, energy is not generated.

The economic factor must also be taken into account. In order to look at the numbers from the side and understand the rationality of using SPPs in the United States as an energy source, there is a need to give as an example some calculations of economic efficiency.

We will not consider the case in which the solar panel works flawlessly and around the clock, and the installed capacity utilization factor (ICUF) approaches 100%. At night, there is no solar energy, and during the day, due to the different solstice heights, the total output, even under ideal conditions, is no more than 50% of the maximum.

In real conditions, even for well-located SPPs, ICUF delivers 17%.

To assess the economic feasibility of developing solar energy throughout the United States, it is necessary to consider the area with the most unfavorable conditions for this, such as Alaska, where the average number of hours of sunshine per year is about 2060 [6]. This number is significantly higher than in the UK [7], where SPPs have already been built and there are actual economic data on them.

For example, even in the private sector, the cost of 1 kWh received by a solar station is $ 0.0889 while the wholesale price of electricity in the UK is $ 0.0762. If one does not delve into the formulas, the cost of solar energy from such an installation, taking into account all errors and situations when further equipment will need maintenance, is approximately equal to 0.26 $ / kWh for a solar panel.

Now let's compare the cost of kWh received from solar panels with the cost of kWh received from gas-fired power plants (Table 1) [8].

		Cost, £/ kWh
Power of 1000 m3 of natural gas, kWh	9550	
Efficiency	38%	
Power generation from 1000 m3 of gas, kWh	3629	
Cost of 1000 m3 of gas, £	50	0,01
Cost of 1000 m3 of gas, £	100	0,03
Cost of 1000 m3 of gas, £	200	0,06

Table 1. *Calculation of the fuel cost component of 1 kWh for gas-fired power plants*

These data are already close to the data from the SPP. Even under the worst conditions, when the number of hours of sunshine per year is minimal, the cost of 1 kWh generated by SPP is comparable to that of gas power plants. But today the operating costs of SPPs are much higher.

It should not be forgotten that the main share of the cost of 1 kWh of solar energy is accounted for batteries, and one of the negative factors is a short service life of them - only 10 years [9].

The prospects for the development of solar energy in the United States are enormous. The cost of energy received from SPP is comparable to the cost of energy received from traditional power plants. But with today's operating costs for SPPs, their use is not profitable. It is necessary to carry on new research and development in the direction of creating fundamentally new accumulators for solar batteries. Only in this case successful development in this area will be possible.

Список литературы

1. Методология и алгоритм математического анализа многофакторной модели оптимальной конфигурации нетрадиционных возобновляемых источников энергии [Электронный ресурс]. – Режим доступа: URL:https://cyberleninka.ru/article/n/metodika-i-algoritm-matematicheskogo-analiza-mnogofaktornoy-modeli-optimalnoy-konfiguratsii-netraditsionnyh-vozobnovlyaemyh.
2. Солнечная энергия в Соединенных Штатах [Электронный ресурс]. – Режим доступа: URL: https://en.m.wikipedia.org/wiki/Solar_power_in_the_United_States.
3. Цены на нефть [Электронный ресурс]. – Режим доступа: URL: http://www.cdu.ru/tek_russia/articles/3/478/.
4. Альтернативные источники энергии типы, плюсы и минусы. [Электронный ресурс]. – Режим доступа: URL:https://narobraz.ru/avto/alternativnye-istochniki-energii-vidy-plyusy-i-minusy.html.
5. Проект Mesquite Solar. [Электронный ресурс]. - Режим доступа: https://en.wikipedia.org/wiki/Mesquite_Solar_project.
6. Прогноз погоды на месяц и климат Анкориджа, Аляска, США [Электронный ресурс]. – Режим доступа: URL: https://www.weather-us.com/ru/Alaska-usa/anchorage-climate#daylight_sunshine.
7. Климат и погода Великобритании [Электронный ресурс]. – Режим доступа: URL: http://m.britainrus.co.uk/stats/Klimat_i_pogoda_Velikobritanii/.

8. Сравнение стоимости кВт· от солнечных батарей и ТЭС [Электронный ресурс]. – Режим доступа: URL https://zen.yandex.ru/media/napulse/sravnenie-stoimosti-kvtch-ot-solnechnyh-panelei-i-tes-5f48f148c783cc14a71fdb38.
9. Расчет стоимости производства солнечной электроэнергии для собственных нужд домохозяйств в центре Европы [Электронный ресурс]. – Режим доступа: URL: https://habr.com/ru/post/482876/.

References

1. The methodology and algorithm of mathematical analysis of the multi-factor model of the optimal configuration of unconventional renewable energy sources. [Electronic resource]. – Access mode: URL:https://cyberleninka.ru/article/n/metodika-i-algoritm-matematicheskogo-analiza-mnogofaktornoy-modeli-optimalnoy-konfiguratsii-netraditsionnyh-vozobnovlyaemyh [in Russian].
2. Solar power in the United States. [Electronic resource]. – Access mode: URL: https://en.m.wikipedia.org/wiki/Solar_power_in_the_United_States [in Russian].
3. Oil prices. [Electronic resource]. – Access mode: URL: http://www.cdu.ru/tek_russia/articles/3/478/ [in Russian].
4. Alternative energy sources: types, pros and cons. [Electronic resource]. – Access mode: URL:https://narobraz.ru/avto/alternativnye-istochniki-energii-vidy-plyusy-i-minusy.html [in Russian].
5. Mesquite Solar project. [Electronic resource]. – Access mode: https://en.wikipedia.org/wiki/Mesquite_Solar_project [in Russian].
6. Weather forecast for the month and climate of Anchorage, Alaska, USA [Electronic resource]. – Access mode: URL: https://www.weather-us.com/ru/alaska-usa/anchorage-climate#daylight_sunshine [in Russian].
7. Climate and weather of Great Britain [Электронный ресурс]. – Режим доступа: URL: http://m.britainrus.co.uk/stats/Klimat_i_pogoda_Velikobritanii/ [in Russian].
8. Comparison of the cost of kW·h from solar panels and TPP. [Electronic resource]. – Access mode: URL https://zen.yandex.ru/media/napulse/sravnenie-stoimosti-kvtch-ot-solnechnyh-panelei-i-tes-5f48f148c783cc14a71fdb38 [in Russian].
9. Calculating the cost of producing solar electricity for the households' own needs in the centre of Europe. [Electronic resource]. – Access mode: URL: https://habr.com/ru/post/482876/\ [in Russian].