MOBILE LED SYSTEM BASED ON PV-SYSTEM

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Abstract: *An assessment of the potential for using solar energy is given. The problems of using solar energy are addressed and a solution is given.*

Keywords: solar energy, problems of solar energy, PV system, LED system.

INTRODUCTION

In the course of its development, mankind is constantly addresses three interrelated challenges: the food supply, the establishment of natural and artificial environments for the normal functioning and energy security.

In modern conditions the first place is given to energy conservation. The global energy sector is already for a long time is not stable. This is due to many factors, but especially with the energy and environmental policy. As the old energy sources have a number of disadvantages, namely:

1) exhaustibility - according to the International Energy Agency[8], world oil reserves left for 40-50 years, fuel - 40 years, gas - 70 years, coal - 300 years;

2) environmentally unfriendly - because of rapid technological development anthropogenic emissions in the air long exceeded natural and reached values of greater than 20 billion tonnes, including: CO2 - 17 billion tonnes, dust and particulates - 200-250 million tons of CO - 30 million tons to 150 million tons of sulfur oxides, 70 million tons of nitrogen oxides, etc.

Until 2000, according to various sources, mankind consumed about (58-65%) * 10^{10} tons of standard fuel (energy per ton of standard fuel is equivalent to 2.93 * 10^7 kJ), but the most important thing is that half of the energy used is last quarter century.

Modern energy is mainly based on the use of minerals - coal, oil, natural gas, which are non-renewable (exhaustible) sources of energy, but coal, oil and gas are not only fuel, but also an important raw material for the chemical industry. Use this raw material as fuel, - as D.I. said Mendeleev, is the same as stoking a stove with bank notes.

It is because of this began to actively develop renewable energy sources, but it is the development and implementation of the energy system was very slow. At this time, the EU decided to act, and adopted a "Plan 20-20-20", which is based on:

- 20% reduction in EU greenhouse gas emissions (or 30% in the framework of international agreements);
- 20% share of energy from renewable sources;
- 20% increase in energy efficiency.

These targets are to be achieved by 2020. A final objective of the plan is to limit the average global temperature rise to 2 degrees.

By 2016, the statistics on the share of renewable sources in the world is as follows (Table 1):

Table 1

The share of renewable sources in the world

A country	*The share of renewable sources,%*
China	*35*
Japan	*24*
India	*18*
USA	*10*
New Zealand	*22*
Turkey	*12*
Chile	*11*
Australia	*10*
European Union	*18*
Sweden	*55*
Finland	*39*
Latvia	*37*
Austria	*33*
Denmark	*32*
Estonia	*29*
Portugal	*23*
Croatia	*28*
Lithuania	*26*
Romania	*25*
Slovenia	*21*
Bulgaria	*19*
Italy	*17*
Spain	*23*
France	*16*
Greece	*15*
Czech	*15*
Germany	*25*
Hungary	*13*
Slovakia	*12*
Poland	*11*
Ireland	*9*
Cyprus	*9*
The United Kingdom	*12*
Belgium	*8*
Malta	*6*
Netherlands	*6*
Luxembourg	*5*
Other countries	*<5-10*

Consider the global statistics of the annual addition of renewable power from 2012 to 2018. (Fig.1)

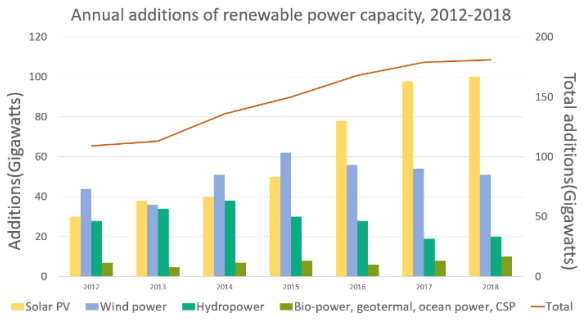

Fig. 1. *- The annual addition of renewable power in the world for the year 2012-2018*

From Figure 1 we can see that the share of energy produced from the sun is the greatest. If we consider the use of energy, we see that on 26.2% of the renewable energy have to only 2.4% solar energy accounts for (Fig. 2). It can be concluded that it has an inexhaustible potential which unfortunately is used at very low levels.

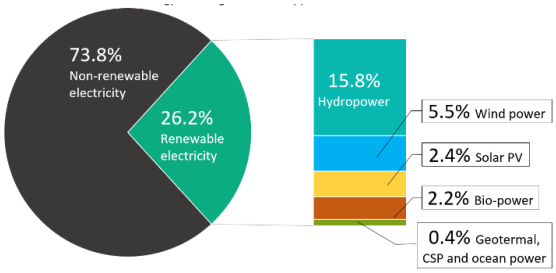

Fig. 2. *- Estimated share of renewable energy in the global electricity production in 2018*

As mentioned earlier solar energy potential unimaginably high and is virtually inexhaustible, according to preliminary estimations of scientists coming 4 billion years, the sun will still give energy. The last decades of the solar potential is widely used by mankind to produce energy using PV systems. Despite the obvious advantages of such systems, they have a significant drawback - a low level of energy of the sun, caused by the close proximity of the solar cells to the ground, making it difficult to select the solar energy to a greater extent. This is due to the fact that most of the time, the cloudy weather prevails in many countries. Preliminary calculations have shown that under such conditions in the atmosphere is lost approximately 75% of solar energy (Fig.3).

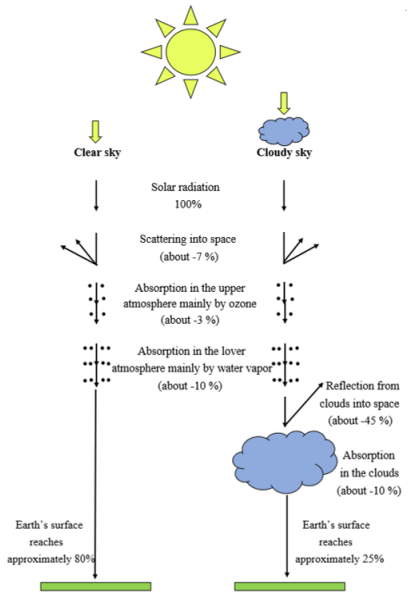

Fig. 3. *Passage of the solar radiation through the atmosphere*

This is a limiting factor for the transition from the old, not environmentally friendly and inefficient methods of energy production to alternative, including a more economical and environmentally friendly as the PV system.

EXPOSITION

Analysis of works devoted to issues [1,2,3] testifies to its relevance and economic feasibility of PV systems to solve the problem of economic efficiency and environmental safety of energy sources.

In [1] reviewed the condition and the evaluation of solar energy, in [2] the prospects, in [3] the comparative evaluation of various solar energy technology. The [5,6] emphasizes the need to further improve the efficiency of PV systems due to increase in efficiency of the sun.

The aim of this work is to develop a lighting system based on LED light sources powered PV systems with improved use of solar energy.

As the study [5], the potential use of PV systems in the world is still quite low. For example, in Ukraine in 2011, built and put into operation at the SPS at 742 MW, according to GP Energy Market is only 0.53% of the total volume of electricity produced in Ukraine. It should be noted that the average level of solar radiation in different regions of Ukraine is quite high (Table 2).

Table 2

The average level of solar radiation in different regions of Ukraine

Regions	*The average level of solar radiation*
Simferopol	*3.58*
Vinnitsa	*3.11*
Lutsk	*2.99*
Dnieper	*3.36*
Donetsk	*3.34*
Zhitomir	*3.04*
Uzhgorod	*3.16*
Zaporozhye	*3.44*
Ivano-Frankivsk	*2.94*
Kiev	*3.10*
Kirovograd	*3.30*
Lugansk	*3.34*
Lviv	*2.92*
Nikolaev	*3.55*
Odessa	*3.55*
Poltava	*3.25*
Rovno	*3.01*
Sumy	*3.16*
Ternopol	*2.99*
Kharkiv	*3.26*
Kherson	*3.55*
Khmelnitsky	*3.06*
Cherkassy	*3.24*
Chernihiv	*3.03*
Chernovtsy	*2.94*

As shown in Table 2, Ukraine has a good potential of solar energy, but its efficiency is low.

As a solution to the problem of increasing the efficiency of solar energy as a mobile system with LED lighting powered by PV source used to illuminate large areas. Using such a system allows for due to use mobile aerostatic installation installation daytime PV modules to a height of 2.5 km, where solar activity up to 100%, and return it at night in close proximity to the illuminated object. Orientation of aerostatic installation relative to the sun is accomplished by lateral motor, and the vertical orientation - by central. As a mobile station, intended use the airship type Aerosmith with such characteristics:

weight of the empty unit: 120 tonnes,
takeoff weight of 290 tons,
body diameter "lens": up to 180 m
body "lens" height: up to 36 m,
shell volume from 500 000 cubic meters. m
the volume of helium: not less than 100 000 cubic meters. m
internal air volume from 400 000 cubic meters. m
flight speed up to 120 km / h,
altitude: 2500 m,
payload: 200 tons.

Fig. 4. *Visualization of the dynamic LED-PV model*

As is known, in most European countries predominate cumulus clouds which are located at the height from 400 m to 2.5 km, thus the height of lifting systems be sufficient to obtain much larger quantities of solar energy.

The system is as follows. On top of the hemisphere are arranged flexible solar panel. Characteristics calculations of mobile LED-PV system are performed for the panel 290 W,

Percium jam6 (L) 60-290 / PR, JA Solar with the following characteristics:
size: 1650 × 991 × 35
weight: 18 kg
power: 290 Watts
degree of protection: IP67

Fig. 5. *General view of PV panel*

Calculations have indicated the possibility of obtaining electrical power up to 2 MW.

At the bottom of the hemisphere are arranged flexible LED panel. Calculations are performed for the S-2610 SMD panels with the following characteristics:
illumination at 1 m: 2400 Lux,
the amount of radiation elements: 504 surface LEDs,
color temperature: changeable 3000-5600K °,
control of light flux: 0-100%,
angle light flux: 120º,
power consumption: 100 W
dimensions: 600 × 460 × 10 mm,
weight: 0.46 kg
kit weight: 1.39 kg.

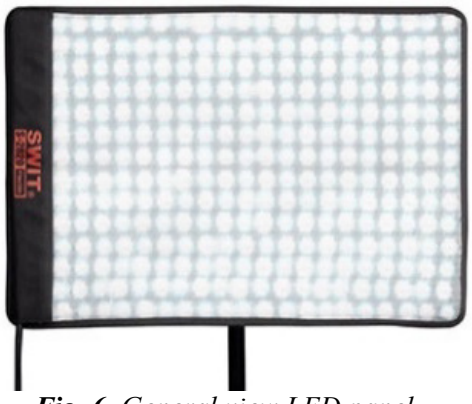

Fig. 6. *General view LED panel*

Calculations have indicated the possibility of obtaining light flux 200 Mlm.

Such a mobile system during daylight it collects solar energy in capacitor batteries housed inside, wherein the automated motor control system of the balloon provides maximum selection light energy by allowing the modules required orientation relative to the sun. At night, located above the object it gives the stored energy in form luminous flux by LED panel light.

Table 3

The calculated data for the considered mobile system

P	*The total capacity of PV panels*	*2 MW*
n	*Number of LED panels*	*82000 pieces*
F	*Total luminous flux*	*200 Mlm*
es	*The illumination on the ground*	*4 lux*
A	*illuminated area*	*50 × 106 m2*
R	*The radius of the illuminated circle*	*3.9 km*
h	*The height at which is located the airship*	*2.3 km*

Calculations performed for the considered mobile system, indicate the possibility of accumulating a sufficiently large electrical power and light radiation energy sufficient to create a luminance of 4 lux over a radius of 3.9 km.

CONCLUSION

Studies have shown the technical possibility and economic viability of using mobile PV-LED system for lighting large areas. Calculations have indicated that for an airship type Aerosmith possible selection of electric power of up to 2 MW and the radiation of the luminous flux to 200 Mlm.

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