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Solar Panels - Reality or Fantasy?

Abstract

Solar panels are used to convert solar energy into electricity. Solar panels are gaining popularity as reliable and almost completely independent sources of electricity. Their operating principle is quite simple, but the equipment complex for generating electricity from sunlight is highly resilient. The continuous pollution of the environment by waste from thermal power plants leads to an increase in atmospheric carbon dioxide concentration, resulting in an intensifying greenhouse effect. This has negative impacts on nature, contaminating drinking water sources, eroding the top layer of soil, and adversely affecting human health. Consequently, it leads to the emergence of diseases in the living nature. To prevent the negative effects of environmental pollution on ecosystems in the modern era, it is both economical and appropriate to utilize alternative energy sources.

The article discusses the main types of solar panels, their advantages and application areas, how and where they should be correctly installed, what components they consist of, whether they can be used in the private sector, and the economic benefits of utilizing modern technologies.

Keywords: *Environmentally friendly, solar panels, electricity supply, solar energy, climate conditions, monocrystalline*

Introduction

Years ago, obtaining free electricity seemed like a fantasy. However, as technology advances, the alternative energy sector is gaining more popularity. Solar panels can indeed be an effective energy source under certain conditions. Therefore, let's take a look at how effective solar panels can be in our climate zone.

The natural climatic conditions in Azerbaijan create opportunities to increase electricity production using solar energy. Our country has between 2400 - 3200 hours of sunshine annually. Therefore, the largest solar power plant in the Caucasus has been established in the Garadag region of our country. The plant has a capacity of 230 MW and utilizes 570,000 solar panels. By 2030, with the construction of solar power plants in Bilasuvar, Neftchala, and Jabrayil, the total capacity generated from solar power plants in our country is expected to exceed 1 GW, surpassing 25% of the total energy production.

Main part: Solar panels can be used to provide electricity for houses, cottages, and vacation homes outside the city. They can also be used for mobile homes and buildings located far from main power transmission lines. In short, they can be utilized anywhere there is space for installation and a need for an additional energy source (1).

Research

Solar panels are a system composed of multiple interconnected photovoltaic cells. The photoelectric effect is the phenomenon where materials emit electrons as a result of light exposure. These cells convert solar energy into electric current. Solar panels can achieve efficiencies of up to 40%, but this requires suitable conditions. Generally, it makes sense to install such systems in areas with many sunny days throughout the year. Additionally, the geographic latitude of your home

should be taken into account, as solar radiation diminishes as one approaches the poles. However, if there are many sunny days in your region during the winter season, solar panels can significantly reduce electricity consumption from the city grid.

Solar panels are divided into three main types:

1) Monocrystalline solar panels are made up of many individual cells filled with silicon. This type of solar panel is effectively used in marine transportation due to its water resistance. Monocrystalline panels are characterized by their relatively light weight, compact size, flexibility, reliability, and durability. They are easy to install and are directly dependent on sunlight.

Even light cloud cover can cause a halt in energy production. Monocrystalline solar panels are shown in figure 1.



Figure: 1. Monocrystalline solar panels

2) Thin-film solar panels are a type of solar cells used to convert solar energy. Their main characteristic is that they are made from less material compared to traditional silicon-based solar panels (2). Thin-film solar panels are shown in Figure 2.



Figure: 2. Thin-film solar panels

The thin-film solar panels have several advantages and disadvantages:

Advantages:

Lightweight: Thin-film panels are easier to install on difficult and non-standard surfaces (such as building roofs) because they are lighter and more flexible.

Lower manufacturing costs: The production of these panels requires less energy, which reduces their costs.

Energy production: Thin-film solar panels can perform better in certain weather conditions (such as cloudy or shaded environments).

Flexible materials: These panels can be produced in various shapes and sizes, making them more suitable for custom projects.

Negative aspects:

Lower Efficiency: Thin-film solar panels typically have lower energy conversion efficiency compared to silicon-based solar panels.

Shorter Lifespan: Generally, thin-film panels may have a shorter lifespan, which can be a disadvantage for consumers planning long-term use.

Space Requirement: More extensive solar panels may be needed to produce the same amount of energy (4).

Usage areas:

Thin-film solar panels are typically used on building rooftops, solar power plants, and portable energy systems.

Overall, thin-film solar panels have advantages in specific applications and environments, playing an important role as a modern solution in solar energy production.

3) Half-crystalline solar panels – these panels contain crystals oriented in different directions within the cells. This allows them to capture diffused light and be less dependent on direct sunlight. This type of solar panel is primarily produced in the form of the blue panels we are visually familiar with. They are slightly cheaper than monocrystalline models and are successfully used for lighting homes, administrative buildings, and even streets (5).

Why solar panels specifically?

1. The sun is almost everywhere. As long as there is access to sunlight, electricity can be generated through these devices.

2. Autonomy. There is no need to connect to a central power supply. As a result, it is possible to reduce the overall costs of the home. You are not dependent on the pricing policies of the energy companies in your area.

3. When it comes to running electrical cables to remote villages and farms, sometimes it is cheaper to install solar panels.

4. Environmental cleanliness. This is the main advantage of this technology. There is no need to use non-renewable natural resources, which is well known.

Solar panels can be used in the residential sector. Solar panels can be successfully utilized not only on an industrial scale but also in the field of individual construction. With the start of production of products by local manufacturers, their prices have significantly dropped below those of Western analogs. Over time, the cost of installations decreases, making them more accessible to a wider audience. Manufacturers usually offer their products with a working period of 25 years (3).

Now calculate the number of sunny days in your region. Divide the cost of the equipment by 25 years and then divide that result by the annual sunny days. This will help you determine if these systems are beneficial for you. Additionally, consider the area needed to produce 1 kW of electricity. You can find this information from vendors or consultants who offer solar panels. Also, take into account the active solar radiation period, which is usually during the summer months. Now think about what your electricity needs are during this period. Solar panels can provide excellent lighting solutions. What is often not mentioned in advertising brochures is that the batteries will need to be replaced regularly (6).

Even the most efficient photovoltaic devices first store electrical energy in batteries and then send it to the home's electrical supply system. By being informed about the lifespan, cost, and capacity of regular car batteries, one can determine how much the maintenance of solar batteries will cost. More effective specialized energy storage units will be significantly more expensive and ultimately may not be cheap at all. Additionally, it is important to consider the efficiency of the available models. Even the best ones may not work effectively everywhere, especially in areas with low sunlight. It is known that a battery covered in dust will operate less efficiently. Therefore, it is crucial to think about the timely and regular cleaning of the panel's surface. Furthermore, in hot weather, the electronics may refuse to operate. Currently, these technologies are not accessible to all members of society. However, modern trends indicate that the existing shortcomings will be addressed in the near future, and that scientists will find new methods for producing cheaper models, making them accessible to everyone.

Is it possible to use solar panels for a private home? One of the advantages of a private home is its ability to be modified. This is also possible with alternative energy sources. Solar panels for a private home are, to this day, the best way to provide environmentally friendly electricity for oneself.

Which area to strengthen. Installing solar panels on the roof is clearly an option for private homes, but it is not always the best solution. A south-facing roof naturally provides the best results

for fixed solar panel installations, but this is not the only option. In such an installation, it is important for the roof to be oriented southward. Do not position solar panels on the east or west walls. This way, during the most intense hours of sunlight, only vertical light will fall on your panels, significantly reducing the system's efficiency. Solar energy is not produced continuously. It may be abundant during peak hours, but as evening approaches, production completely ceases. The installation of solar panels on the roof is shown in Figure 2 (7).



Figure 3. Installation of solar panels on the roof

Are solar panels cost-effective for individual homes? In Western countries, interest in solar energy largely stems from ecological concerns, with the pursuit of economic benefit being secondary. However, the situation is somewhat different in our local context. If current electricity prices are maintained, a solar battery system installed for a single home and a family of four can pay for itself completely within 4-5 years. During this time, the lifespan of photovoltaic panels is around 20-25 years, but batteries will need to be replaced every 5-7 years, depending on their quality. Currently, electricity prices are not falling worldwide, so over the lifespan of the panels, the system is likely to pay for itself at least 4-5 times.

The composition of a solar energy battery:

1. Solar panels;
2. Controller that manages the charging of the batteries;
3. Batteries. Selecting the right battery is the most challenging task and is the most expensive component of the system;
4. Inverter. Used to convert direct current (DC) into alternating current (AC) at 220V (8).

The elements mentioned above form the basis for building an autonomous energy system based on solar energy batteries. If desired and within your means, you can calculate and enhance the capabilities of the autonomous energy system in your home. This article will help you get started on obtaining alternative energy and building the system by yourself, as well as support further research on the topic.

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