Prospects and trends of green energy development

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Abstract. The article analyzes trends in the development of green energy. Green energy is the alternative form of energy. The advantage of green energy is due to the fact that it is generated from natural resources such as sunlight, wind, water, tides and biomass. Energy is considered green if the resource does not produce pollution or emit CO_2 which causes the global warming. With the development of technologies, the efficiency of green energy generation increases, and the cost decreases. Due to the high availability of solar and wind types of energy, this industry is becoming more attractive and promising for commercial applications.

1 Introduction

In developed and developing countries, the demand for electricity generated from non-traditional renewable energy sources (RES) has been increasing. One of the alternative types of energy is green energy. It is also called renewable or regenerative energy from inexhaustible sources. Renewable energy is energy generated from natural sources replenished at a faster rate than consumed.

The basic principle of the use of renewable energy is to extract it from processes constantly occurring in the environment and to provide it for technical use. Renewable energy is generated from natural resources such as sunlight, wind, rain, tides and geothermal heat that are replenished naturally. Long-term operation does not have a significant impact on the deficit of these resources, they can renew in a short time. Renewable sources from which green energy is produced include wind, sunlight, water, geothermal sources, sea waves, sea currents and tides, biomass, biogas and biocurrents [1].

In most developed and developing countries, energy is predominantly generated by burning fossil fuels, including coal. It is known that the traditional energy generation methods produce huge amounts of carbon dioxide (CO_2) and other harmful substances that pollute air, soil, ground and surface water [2]. Thus, RES (renewable energy sources) have become an excellent alternative to the traditional methods of energy production due to the fact that the process of energy generation is more clean. Trends in the development of green energy are encouraging. Since 2013, the EU countries have increased the share of energy

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from alternative sources from 14 to 25%. It is also important to note that the leading world corporations support the use of renewable energy sources by investing in this industry [3].

2 Materials and methods

For the present study, statistical data on the use of green energy both in the Russian Federation and in foreign countries were used.

The need for the development of renewable energy is determined by its role in solving the following problems:

- The need for renewable energy development is determined by its role in solving the following problems:
- Ensuring sustainable heat and electricity supply to the population and production in the areas of decentralised energy supply, primarily in the Far North and equated areas. Fuel supplies in these areas amount to about 7 million tons of petroleum products and over 23 million tons of coal;
- Ensuring a guaranteed minimum supply of energy to the population and production in the areas of centralised energy supply experiencing a shortage of energy, and preventing damage from emergency and restrictive shutdowns;
- Reducing harmful emissions from energy installations in cities and towns with a complex environmental situation, as well as in places of mass recreation of the population [4].

Currently, various technologies for the extraction and use of energy have been developed and are being improved, which makes renewable energy sources more competitive compared to the traditional ones [5].

3 Results

A few years ago, green energy was not able to compete with the oil sector, but investors began to show interest in its development [6]. Banks and rating agencies did not fund the companies. Green energy was unprofitable and occupied an extremely small share in the electricity market. Oil, gas and coal were considered the main sources of energy, and the long-term payment of dividends by such companies left them in the constant focus of investors [7]. However, the situation has changed. Large industrial enterprises are investing in the development of the renewable energy sector. It is expected that by 2050 renewable energy sources will have replaced gas, oil and coal [8]. Consider the alternative of green energy on a ten-point scale presented in Figure 1.

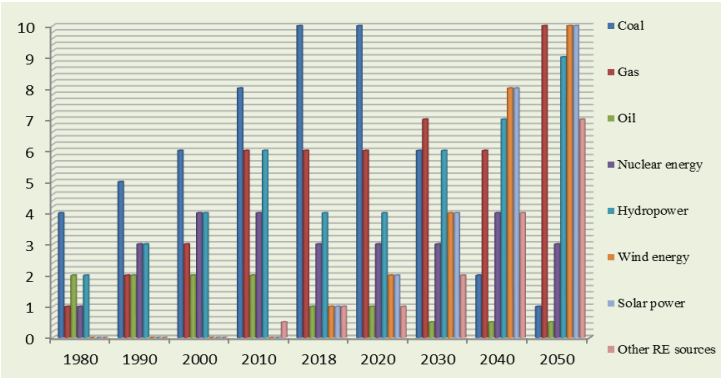

Fig. 1. A green energy perspective.

Figure 1 shows a significant increase in the share of green energy since 2020, the demand for wind energy, solar energy and other renewable energy sources is increasing [9]. However, up to 2020, the main sources of energy were oil, gas and coal [10].

Thus, it can be said that the transformation of energy into green energy affects many sectors of production:

- Energy producers.
- Traditional generators.
- New energy industries.
- Producers of solar panels, wind turbines, batteries.
- Infrastructure transport companies.
- Enterprises dealing with hydrogen technology.
- Enterprises engaged in metal mining (including uranium mining) [11].

The companies represented and a number of other industrial enterprises will have a strong impact on the growth trajectory in each individual segment of energy generation [12].

Today, the situation has changed. Large industrial enterprises are investing in the development of the renewable energy sector.

The renewable energy sector produces fewer emissions than the fossil fuels one [13].

Consider the countries of the European Union, where the main source of green energy is wind. The share of wind energy in the EU is about 30% of all green energy produced; it makes up about 11.6% of the total energy mix [14]. The European Union has set a goal of producing 26-35% of all energy from wind by 2030. Table 1 shows the share of green energy generated in 2022.

Table 1. Share of renewable energy in countries (%).

Country/region	Share in the energy mix
European Union	39
China	28
USA	21
India	20
Japan	20
Russian Federation	20

Table 1 shows that green energy dominates in the European Union and China. In the European Union, the main alternative energy source is wind. Since 2016, Denmark, Portugal, and Germany have been using more renewable energy than other EU countries [15]. The shares of RES are presented in Figure 2.

Figure 2 shows that wind and solar renewable energy sources ("green energy") prevail in the EU countries. Currently, wind farms are considered the most efficient sources of green energy as they require less processing than solar panels. Technological advances and testing of composites have helped extend the lifespan; benefits of wind turbines have become evident. However, the same can be said about solar panels whose production is developing.

When it comes to the Russian Federation, Russian businesses and private consumers are switching to renewable energy sources. New solar energy technologies will change the country's energy industry. Globally, renewable energy generation is already demonstrating competitiveness compared to traditional energy. According to forecasts of the International Energy Agency, by 2050 solar power plants will be able to produce up to 25% of electricity in the world [16].

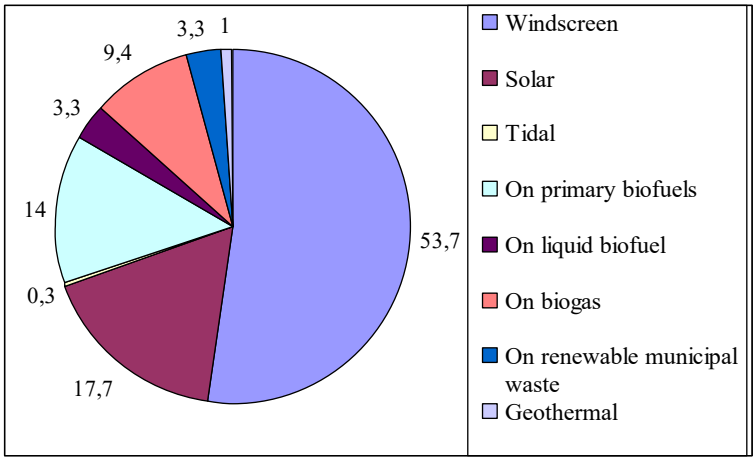

Fig. 2. Aggregated structure of green energy production (by foreign country).

In Russia this niche is not occupied yet, because the market of alternative energy has started to develop only in the last two years and still does not exceed 1-2%. However, 73% of solar power plants with a total capacity of 1 GW 66 MW have been commissioned in the last three years, showing considerable growth for the Russian Federation [17]. Developments in technology and laws passed in Russia are increasingly pushing the development of green generation.

4 Discussion

The green energy efficiency depends on a location, as under proper conditions, such as frequent and strong sunlight, it is easy to produce energy. However, to compare different types of energy, it is necessary to analyze the life cycle of an energy source. This involves the evaluation of the energy used to create a green energy resource, the determination of how much energy can be converted into electricity, and the environmental cleanup required to create an energy solution [18]. Green energy has a number of positive trends that are shown in Figure 3.

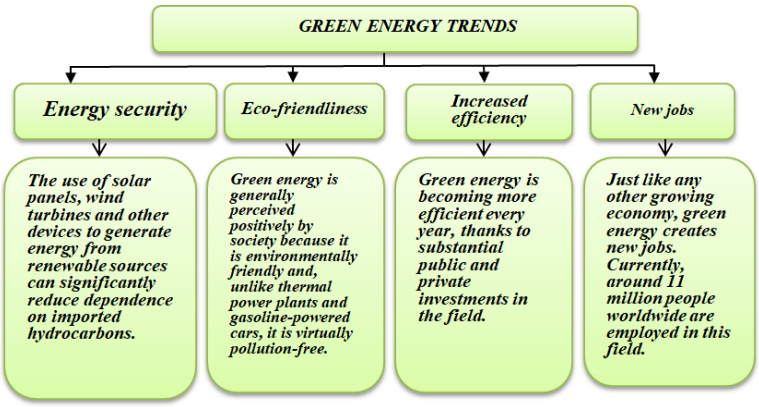

Fig. 3. Trends in green energy development.

According to the positive trends of the green economy, one can say that the green energy sector is developing, and the world community is rapidly abandoning unnatural

methods of energy production. This is a chance to live on the planet where the air is not polluted by emissions from factories, in harmony with nature [19, 20].

5 Conclusion

Humanity has been generating carbon dioxide since the first fire struck by flint. Heat production by burning carbon fuels (from dry wood to LNG) is the main way to generate energy. When carbon is oxidized, its oxide, CO_2, is formed, and nothing can be done to prevent it. Therefore, green energy development implies the rejection of coal, oil and natural gas.

But if we abandon the use of carbon, what sources of energy will be used. Due to scientific achievements implemented into practice, the energy can be generated from green renewable sources. Green energy means alternative energy. The processes that occur in the environment become energy sources. Green energy has both advantages and disadvantages

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