

# Problems and Prospects of “Green” Energetics Development

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**Abstract** — In the world, due to the coming out of the recession, increasing the level of well-being of people in developing countries and population growth, there is an increase in energy consumption. According to the International Energy Agency, the power industry is the source of 42% of anthropogenic emissions of greenhouse gases. In recent years, there has been a demand for environmentally friendly energy - solar, wind. Supporters of traditional generation reject the validity of the transition to renewable energy sources (RES), especially in Russia, where gas, oil and coal reserves will last for decades to come. However, the risks of technological lag behind developed countries, environmental issues and the enormous potential for the application of renewable energy technologies stimulate the Russian government to create a renewable energy industry in Russia, while the rest of the world is already on the path of sustainable growth of a new industry.

**Keywords** — energy, greening, renewable energy, energy balance, sustainability, energy market

## I. INTRODUCTION

The environmental situation in the post-industrial time, unlike the industrial period, will become more complicated not only in the direction of exacerbating existing environmental problems and the emergence of new environmental threats, but also in solving many environmental problems, environmental improvement of people's lives and alleviation of human pressure on nature. At the same time, the pace and characteristics of the development of positive environmentally significant processes will largely depend on the pace and quality of post-industrial processes in the world.

Post-industrialism generates pockets of environmental health, which coexist and intertwine with pockets of trouble, formed mainly in the industrial age. Geographically, this will be expressed in the fact that pulsating areas of ecological recovery will be superimposed on pulsating environmental crises and areas of environmental distress. In the future, in more developed countries, these pulsations will be more manageable and more environmentally friendly. Thus, the general panorama of the ecological situation in territories of different scales will be even more mosaic and controversial.

Today, there is a reason to say that it was post-industrial tendencies that relieved for a certain period the tension in assessing the ecological situation on the planet, which was reflected in the transition from panic-alarmist to more restrained

and even moderately optimistic environmental assessments of world development.

Within today's post-industrial period of society development, there is a growing generalization of judgments about the future of mankind. Perhaps this is facilitated by the characteristic features of the period, such as the informatization of society, increasing level of education, innovations through the unity of technical and scientific achievements. They are taken as a basis for economic sustainability of countries, which ultimately leads to an awareness of quality of life of both the producer and the consumer [1].

The present stage of development of society, with a bias of understanding of the future, is natural; the mankind has already faced such global problem as depletion of natural resources, signs of ecological disaster and poverty.

Innovative activity, which is the driving force of social and economic development of society, claims to be a panacea in solving ecological and economic contradictions. In this case, material progress may not necessarily be achieved only through damage caused to the human environment. Environmental technologies account for about 5-10% of all patented inventions in the world. The leading positions are traditionally occupied by the USA, Asian countries - by the Republic of Korea, Japan and China, European countries [2].

Power complex is not just a key element of world politics, but also one of the main environmental problems. The world will experience an increase in energy consumption due to the increasing level of welfare of the inhabitants of developing countries as well as to the population growth. By 2030, according to the forecast, the number of the Earth inhabitants will have reached 8.5 billion, and by 2050 – 9.7 billion [3]. This leads to the fact that electricity consumption will grow by 40-50%.

Power generation at the present stage is mainly based on the burning of mineral resources and on nuclear power. Currently, the share of nuclear generation in Russia is about 19% of the total electricity generation in the country.

The peculiarity of Russian power complex is the presence of huge hydro resources, which are successfully used for electricity production.

The demand for electricity and heat depends on the dynamics of economic development of the region (country). There is a significant imbalance in Russian power sector: the

Central part accounts for 70% of GDP and 60% of energy consumption, while 80% of energy resources are produced in the Eastern part of the country. The fact that production and consumption coincide in time does not allow stocking up the goods for future, and therefore we need an accurate forecast of demand.

Together with the growth of electricity consumption, growing is the demand for environmentally friendly ("green") energy, such as the one from solar or wind sources.

## II. RESULTS AND DISCUSSION

Efficient renewable energy policies should take into account the interaction and interdependence of factors affecting renewable energy supply and sustainability.

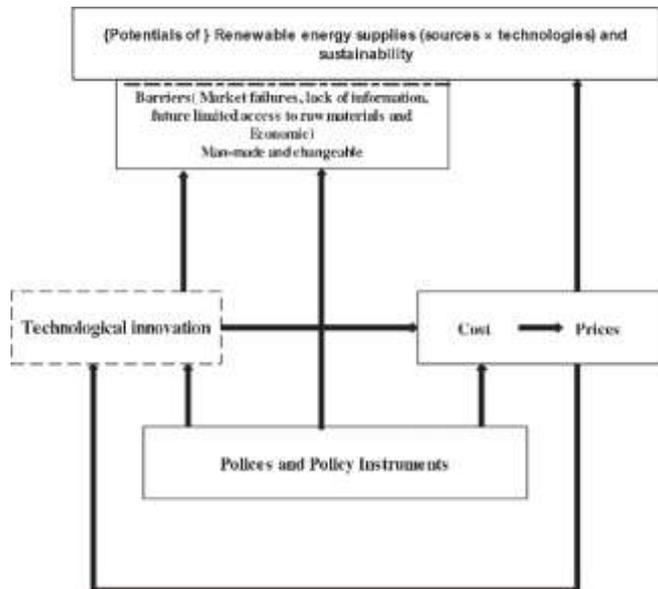


Fig. 1. The interaction and interdependence of factors affecting renewable energy supply and sustainability, according to the data of Edenhofer et al. (2011); Verbruggen et al. (2010) [4]

Renewable energy (without large hydropower plants) prevents dangerous changes in the environment:

- during the construction of mines and open-pit mining (coal, uranium), drilling (natural gas, oil), laying pipeline systems (gas, oil, oil products). Some of these environmental changes are local in nature, and some are spread over many hundreds and thousands of kilometers;
- due to air and water pollution: acid rain, smog, heavy metals, dirty water when drilling wells;
- due to global climate change because of fossil fuel combustion;
- due to thermal pollution (discharge of cooling water from nuclear and thermal power plants);
- due to environmental pollution at the stage of transportation and processing of coal and uranium [5].

The peculiarities of alternative energy include its low intensity and large scattering in space with a density of less than 300 W/m<sup>2</sup> [6].

According to the International Energy Agency, electricity is the source of about 40% of anthropogenic greenhouse gas emissions, which affects not only the environment and quality of life, but also the level of state spending on social security, health, environmental measures, etc. In the countries with higher incomes, there is a steady increase in the solvent demand for environmentally friendly, reliable, affordable energy as an important element of the quality of life.

Russia has got a great potential for the use of renewable energy sources (RES).

One of the most important characteristics of renewable energy sources is their energy potential - an indicator that determines the amount of energy characteristic of the respective type of renewable energy sources. To assess the energy resources of renewable energy sources that can be used, the following types of energy potential of renewable energy sources are distinguished:

- theoretical, characterizing the total amount of energy;
- technical - part of the theoretical potential, which in principle can be used with the help of modern devices;
- cost-effective - part of the technical potential, which is now appropriate to use, based on economic, social, environmental and other factors.

The impetus for creation of the renewable energy industry in Russia was given by the risk of technological backwardness in comparison with the developed countries, as well as environmental problems.

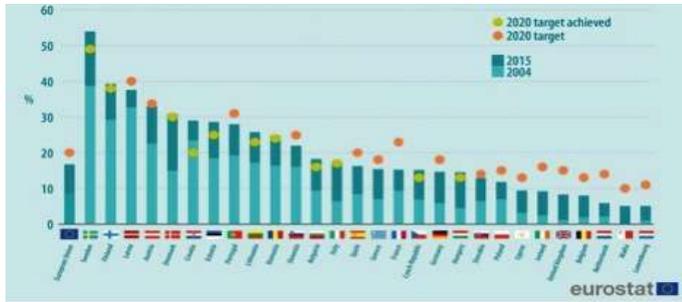
In 2007, amendments were made to the Federal law "On electric power industry", where it was proposed as one of the measures to support renewable energy, to pay price premiums to the equilibrium price of electricity in the wholesale electricity and capacity market (WECM).

Later, it was replaced by the mechanism of agreements on providing capacity of renewable energy generating facilities, through which renewable energy facilities receive a fixed monthly fee for installed capacity.

TABLE I. ASSESSMENT OF THE POTENTIAL OF RENEWABLE ENERGY SOURCES IN RUSSIA [7]

Resources	Gross potential, mln. tons conventional units per year	Technical potential, mln. tons conventional units per year		Economically efficient potential, mln. tons conventional units per year	
		2010	2020	2010	2020
		Solar energy	2205400	9695	29900
Wind energy	44326	2216	3324	11	18
Small energy	402	126	160	70	91
Biomass energy	467	129	170	69	88
Geothermal energy	29200	11869	1300	114	125
Low-grade heat	563	194	220	53	70
Total RET	2251158	24229	35074	320	572

This differs significantly from the support schemes used in most countries of the world. The creation of this mechanism became possible due to the peculiarities of Russian market, where, along with the generated electricity, the installed capacity of power plants is paid for. In addition, Russian government, using this feature, controls the volume of RES power, as well as establishes a medium-term price indicator for marginal capital costs and the minimum permissible level of installed capacity utilization factor of power plants, which minimizes the impact on the price of electricity for consumers. In 2013, a mechanism was adopted to promote the use of renewable energy sources in the WECM and the target index for the share of renewable energy in the power sector was set at 2.5% by 2024.



development of renewable energy sources in Russia. Both consumers, who bear increased payments for the payback of "green" projects, and representatives of traditional energy, have been steadily against the extension of existing support measures. According to Vygon Consulting, in 2025-2040, with the growth of the price of gas and coal at the level of inflation, the effect of reducing electricity prices in the wholesale market due to the "free" generation of "green" energy will be 400 billion rubles. [10].

Currently, alternative energy sources in Russia account for about 20%, if we consider "large" hydropower and nuclear energy. The latter can be considered low-carbon, although not renewable (as is has been done in the Power Strategy). But if, as the rest of the world, we separate "large" hydropower and nuclear power from RES, than, in accordance with this Strategy, the share of renewable energy in Russia should have been 8% to 11% by 2030 [11].

The start of the development of industrial wind power was put in early 2018 with the launch of the 35 MW "wind park" in Ulyanovsk. Due to abundant coastal areas, Russia has the greatest potential in wind energy.

Another direction of RES is the development of the world solar energy complex accompanied by its spatial expansion. Currently, we can see the process of new growth poles emergence which leads to the polycentric model of territorial structure of the industry with three main centers:

European – with Germany, Spain, Italy and Great Britain;

American – with the USA;

Asian – with China and Japan [12].

The factors of accelerated development of solar energy are:

- 1) accessibility and inexhaustibility of solar energy;
- 2) high level of environmental safety;
- 3) significantly lower capital and operating costs compared to traditional hydrocarbon energy;
- 4) constant decrease in the cost of solar modules.

There is no single, common for all countries, factor in distribution of solar energy at the meso level. It depends on the socio-economic conditions and state specifics.

Sunlight does not need extraction and transportation, it is weightless, silent and, as a rule, harmless, and its utilization does not create direct waste and does not disturb the thermal equilibrium of the planet. Therefore, the fundamental difference of solar energy from all the traditional energy sources used is its impeccability in terms of chemical, thermal and other types of environmental pollution. The properties already listed make it a unique candidate for the main role in the energy strategy of the new millennium.

According to the updated data, in the Krasnodar and Stavropol territories, Buryatia, Astrakhan and Volgograd regions 307 solar installations (GU) with a total area of 16440 m<sup>2</sup> (13,15 MW) are operated. In Fig. 3 we can see the structure of solar power stations of Russia by purpose.

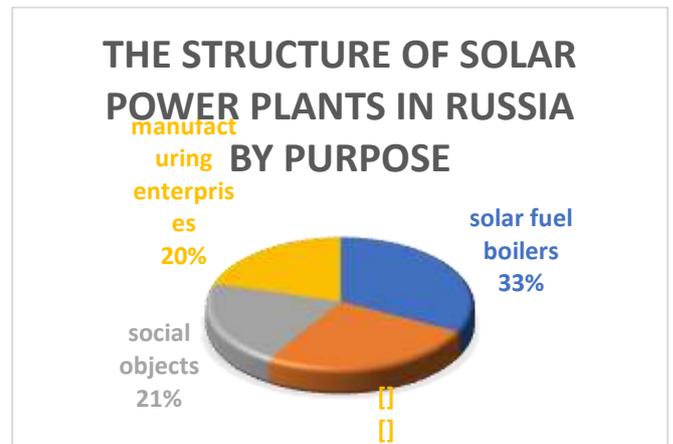


Fig. 3. The structure of solar power plants in Russia by purpose

Dominating are solar-fuel boilers 4756 m<sup>2</sup> (28.9%). The second place is occupied by the plants of hotels and resorts - 3826 m<sup>2</sup> (23.4%). A large group includes the plants of social facilities - 3014 m<sup>2</sup> (18.3%) and industrial enterprises - 3000 m<sup>2</sup> (18.3%). Single-family houses possess 1345 m<sup>2</sup> (8.2%) and so on [13].

For different climatic conditions, certain architectural and typological characteristics of site development are used [14]. Today there are many different types of alternative energy facilities, but the most common in architecture are solar energy facilities, which produce up to 1.2% of the world energy [15].

In Siberia, the development of renewable energy sources is determined by the long distances and presence of hard-to-reach places. The presence of snow cover can be used as another "mirror" that reflects the sun's rays onto the surface of a solar collector or module, thereby increasing the total amount of solar energy produced, and as a result, the amount of electricity generated.

The most prospective for the development of solar energy are regions with decentralized energy supply, hard-to-reach and isolated zones, as well as specially protected natural areas: reserves, national parks. Solar-energy complexes are mainly built where there are no power capacities and networks at all.

In Buryatia, there is already the experience in the use of RES. In October 2017, a solar station with a capacity of 10 MW was launched in Bichura district. The second solar power plant will be launched in Khorinsk district.

### III. CONCLUSION

Due to the existing unfavorable environmental conditions, the use of renewable energy sources can somehow mitigate the effects of human activities. This approach will ensure that the energy needs of future generations are met.

Today's Russia is characterized by a number of factors that contribute to the development of "green" energy, alternative use of traditional energy sources:

- 1) high scientific and technological potential of Russia;

2) sufficient level of solar radiation in most part of the territory of Russia;

3) the possibility of using hybrid plants (combining different renewable energy sources) to provide round-the-clock power generation

The main problems hindering the development of alternative (primarily solar) energy include:

- our mentality that has developed over a long period - we trust more in large centralized energy capacities, and small installations seem to us not so reliable and effective;
- Russians, as residents of the richest in natural resources country, are not afraid of the idea of the exhaustion of resources;
- the inconstancy of the sun and wind complicates their use, so an additional basic energy source is needed, which significantly increases the cost of the entire system. Also, the enormous costs will require the conversion of buildings, because during the construction they were not designed for solar and wind turbines;
- the trend of the European Union to reduce the consumption of gas produced by Russia means that there will be a reorientation towards consumers within the country, and this in turn will significantly push back renewable energy sources.

1) the lack of a clear regulatory and legislative framework at the Federal level;

2) redundancy of power generation capacities in Russia;

3) availability of fossil fuel reserves and, as a consequence, the high role of the development inertia factor;

4) well-established system of centralized heat and electricity supply;

5) the high cost of solar installations, which limits their wide use by individual consumers.

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