Power industry of future is renewable sources

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Abstract. The article provides the definitions of "green technology" and "renewable energy". It describes the areas of impact and application of these technologies and the main types of renewable energy sources in nature. The article shows a strategy for the development of renewable energies in a sample of world economic leaders, including the development of these types and modes of energy generation in Russia. The article concludes that the future use of renewable sources of energy, not only in our country but also on a planetary scale, is appropriate.

1. Introduction
The development, use and elaboration of sources of renewable natural resources in the modern world is a necessity. By groups of types and ways of using these resources we mean such a thing as “green technologies”. This concept implies using and implementing innovations based on the principles of sustainable development and reuse of natural resources.

The general approach of “green technologies” suggests reducing the level of emission of harmful substances into the Earth’s atmosphere during the processes of obtaining the necessary resources for the life-sustaining activity of people.

According to the classification of the Organization for Economic Cooperation and Development, today "green technologies" embrace the following spheres of influence [1-5]:

- production waste management;
- prevention of pollution of the lithosphere, hydrosphere, atmosphere of the Earth;
- energy production from renewable sources;
- mitigation of the effects of the Earth's climate change;
- fuel utilization efficiency increase;
- improving energy efficiency in buildings;
- improving the energy efficiency of lighting devices;
- renewal of land.

In fact, "green technologies" are involved in all areas of the economy: energy, industry, construction, transport, agriculture and other areas. Currently, these technologies are being implemented in all processes of organizations, including, in addition to product manufacture and raw material consumption, management and further processes of working with distribution channels of products.

But still, one of the priority values of the use of "green technologies" in the world is the generation of energy using renewable energy sources.

The term “Renewable Energy Sources” (hereinafter referred to as RES) refers to sources based on constantly existing or periodically occurring processes in nature, as well as the life cycles of plants,
animals and human society. However, RES as the general term includes a wide variety of energy sources.

Today the main sources of renewable energy in nature are the following [6-10].

Wind energy - the conversion of the kinetic energy of the atmospheric air masses into electric, thermal and other forms of energy using wind generators in the form of windmills.

Hydroenergy - the conversion of the energy of the flow of water masses over the surface of the earth, overlapped by erected hydraulic structures (dams).

The energy of sea tides - the production of energy with the aid of special types of hydroelectric power plants, using tidal energy generated by the conversion of the kinetic energy of rotation of the Earth.

The energy of ocean waves - the energy received by wave power stations that convert the potential energy of waves transported over the ocean surface.

Solar energy - the conversion of electromagnetic solar radiation into electrical or thermal energy using solar power plants.

Geothermal energy - the generation of energy by means of thermal power plants that use water from hot geothermal sources as a heat carrier.

Bioenergy - the production of energy from plant or animal raw materials, organic waste products or organic industrial waste.

2. Results and discussion

The share of hydropower in the generation of electricity in the world remains stable: 18.1 percent. It is the “new” types of electricity, primarily solar and wind energy that has become the engine of the rapid growth of renewable energy sources in the world over the past 25 years. During this time their share increased more than 4 times, and by 2030 an approximation to the hydropower share indicator in the global energy sector is predicted (Figure 1) [11-15].

![Figure 1. Shares of different types of fuel in the global electricity generation [16-21].](image)

The development and implementation of renewable energy sources is gaining popularity around the world. For example, presently Australia is one of the world leaders in the installation of photovoltaic power plants, whose share in the Australian energy sector is more than 3 %. According to this indicator, Australia is ahead of the UK, where the total capacity of power plants is twice as high and is about 12 GW.

The undisputed leader in the field of renewable energy sources today is China, which produces more than 60 % of all solar panels in the world. According to the data of the International Energy Agency, the renewable energy generation capacity in China for 2016 was more than 34 GW [22-24].
According to the countries' energy development strategies, up to 2035, China plans to increase the share of renewable energy in electricity production to 15 %, Egypt - to 20 %, EU countries - to 30 %, Russia - to 4.5 % [25-27].

The entire installed generating capacity in Russia is 200 GW. According to the Energy Strategy of the Russian Federation, renewable energy sources generating 8.5 GW should appear in Russia by 2035, while 5.5 GW capacities will have to be introduced by the year 2024 [28-30].

At the same time, the introduction and use of renewable energy sources is gaining popularity even in those countries that have large reserves of oil and gas. For example, Iran plans to build a solar power plant with a total capacity of 2 GW. For these purposes, Iranian company Amin has signed an agreement with the Norwegian manufacturers of solar modules. This agreement is estimated at 2.9 billion US dollars (see table 1) [11].

| Table 1. Global Renewable Energy Indicators [25]. |
|--------------------------------------------------|
| Global indicators of renewable energy, by year   |
| 2009 2010 2011 2012 2013 2014 2015 2016 |
| Annual investments in renewable energy (10^9, USD) 160 211 257 244 232 270 286 241 |
| Gross installed capacities of renewable electricity (GW) 1.230 1.320 1.360 1.470 1.578 1.712 1.849 2.017 |
| Hydroelectric energy (GW) 915 945 970 990 1.018 1.055 1.064 1.096 |
| Wind energy (GW) 159 198 238 283 319 370 433 487 |
| Photoelectricity (GW) 23 40 70 100 138 177 227 303 |
| Heating the water with solar thermal energy 160 185 232 255 373 406 435 456 |
| Ethanol production (10^9, l) 76 86 86 83 87 94 98 99 |
| Biodiesel production (10^9, l) 17.8 18.5 21.4 22.5 26 29.7 30.3 30.8 |
| Number of countries with renewable development goals energy 89 98 118 138 144 164 173 176 |

Large global non-resource-based companies also support the use and development of RES. According to the development strategy of IKEA, the company plans to fully switch to the generation of electricity using renewable energy sources by 2020. For example, presently Apple is the largest owner of solar power plants in the world, due to which all the company data centers operate. The share of RES consumed by Google is 35 %. Today, Google's investment in renewables exceeds $ 2 billion.

In 2014, as part of the climate week, held in New York, RE100 was founded, uniting companies that are switching or planning to switch to renewable energy sources. IKEA, Apple, BMW, Google, Carlsberg Group and other global companies have already joined RE100.
Figure 2. The share of renewable energy in the energy balance of the EU countries [31].

The development and use of renewable energy sources is undoubtedly a contribution to the planet’s green future. In the future, renewable energy sources can replace traditional sources of energy, as well as reduce the costs associated with importing resources.

According to the International Energy Agency, the share of RES in global electricity production in 2015 was about 24%, which indicates the international development of these technologies [22, 32-34].

3. Conclusion
Recently there has been a rapid growth in renewable energy in the world. Their share in the electricity production increased from an insignificant two percent in 2003 to almost 10 percent today, and it is expected to be 11.2 percent by 2020. Plans for Russia are very modest - only 1 percent by 2020, that is, by an order less, and it is doubtful that this target will be achieved. Many countries have even more impressive plans. So, Germany is going to generate 80 percent of energy through renewable energy sources by 2050 [34-36].

The development and implementation of projects based on renewable energy sources contributes not only to the innovation-driven growth of individual countries, including Russia, but also to the improvement of the ecological situation on a global scale.

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