



Analysis on Development Prospect of Renewable Energy Power Generation in Russia

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Abstract: Energy cooperation is an important foundation and support for the “One Belt, One Road” initiative. Russia, a major energy country across Eurasia, has an important strategic position in it. In recent years, Russia has taken energy efficiency, energy conservation and emission reduction, and the development of renewable energy as important breakthroughs for sustainable social and economic development in the future. It hopes to optimize the energy structure through policy support, actively develop and apply clean energy technologies, and develop renewable energy. Achieve a green and low-carbon transition. However, it is no easy task to develop renewable energy in , where the traditional energy industry is so strong. In order to fully display the full picture of the development of renewable energy in Russia, the development of renewable energy in Russia is analyzed and the current renewable energy measures are formulated.

Key words: renewable energy; Sustainable development; Energy structure; “One Belt, One Road” .

1. Introduction

With the excessive consumption of traditional fossil energy sources such as oil, natural gas, and coal and the increasing negative impact on the environment, countries around the world have begun to pay attention to the development and utilization of renewable energy. As a typical resource-dependent economy, Russia’ oil and gas revenue in 2015 accounted for more than 43% of the federal budget revenue. However, in the process of economic development, the environmental costs such as carbon emissions are relatively high. Environmental pollution issues are more severe. In addition, as a major producer and exporter of energy products, Russia has a huge influence on the world energy market and the international political landscape, and energy exports are also one of its important means to gain international voice. Therefore, energy has an extremely important strategic position in ‘s domestic political and economic life and international diplomacy. In recent years, in order to better protect the environment, create employment opportunities, and improve people’s livelihood internally, and to more effectively respond to the impact of the global energy revolution externally, Russia has begun to introduce policies to support the development of renewable energy, optimize its energy structure, and strive to make it greener. Carbon economy and social transformation.

1.1 Energy distribution in Russia

In terms of energy reserves, Russia has extremely rich fossil energy reserves. The total reserves of natural gas are 127 Tm³, accounting for one third of the world's total reserves; the total oil reserves are about 44 Gt, accounting for 10% of the world's total reserves; and the coal reserves exceed 200. Gt, accounting for 12% of the world's total reserves. In addition, Russia's uranium reserves also account for 14% of the world. From the perspective of total energy

consumption, the total primary energy consumption of Russia in 2016 was 673.9 Mt oil equivalent, accounting for 5.1% of the total global energy consumption. From the perspective of energy consumption structure, fossil energy consumption accounts for the vast majority (of which natural gas accounts for 52.20%, oil accounts for 21.96%, and coal accounts for 12.95%). Nuclear energy also has a good development (accounting for 6.60%) Both accounted for 93.71% of Russia' total energy consumption. The development and utilization of natural gas, nuclear energy, and a relatively high amount of hydro-power (accounting for 6.26%) show to a certain extent the “clean and low-carbon” aspect of 's energy structure.^[1]

1.2 Status of renewable energy in Russia

From the perspective of energy production, biomass energy and hydro-power are the main sources of renewable energy in the Belorussian energy system. In 2018, the installed capacity of renewable energy power in was 51 350MW, of which the installed hydro-power capacity was 51,318 MW, accounting for 99.9% of the total; most of the installed hydro-power was large hydro-power (greater than 10MW), reaching 49,667 MW. It accounts for 96.8% of the total installed hydro-power capacity. In terms of energy consumption, except for hydro-power, the consumption of other renewable energy sources in in 2017 and 2018 were both 0.2Mt oil equivalent. As the world's third largest energy consumer after China and the United States, compared with its annual primary energy consumption of 673.9 Mt oil equivalent (2016), the consumption of other renewable energy sources except hydro-power is almost negligible .

Ross is rich in hydraulic resources, with an average annual rainfall of 600-800 mm, a total annual average rainfall of 9 347 km³, and an average total runoff of 6 242 km³. has the world's second largest hydro-power resources. As shown in Table 1, Russia's theoretical total hydro-power reserves are 2395.1 TW·h/a, and the technologically develop volume is 1670.2 TW·h/a, which is economically develop. The amount is 852.4 TW·h/a. So far, only about 10% of the technologically develop amount and 18.8% of the economically develop amount have been developed. As of the end of 2013, 's cumulative installed hydro-power capacity has reached 50.75 GW, and it is expected to reach 56.23 GW in 2025, with an average annual growth rate of 0.9%. Therefore, still has a huge potential for hydroelectric power generation, and only in the region bordering China, Japan, Mongolia and the Korean Peninsula in the east, there are abundant hydro-power resources to be developed. The Belorussian Electric Power Company believes that a new environmentally friendly zero-carbon hydro-power system of 30 GW can be established in this area.^[2]

Table 1 Distribution and development of 's main hydraulic resources

area	Theoretical amount	Economic development capacity (TW·h/a)	Development and utilization (TW·h/a)	Development rate%
European region	338.1	131	55.5	42.4
Western Siberia	200.1	77.4	2.2	2.8
Eastern Siberia	848.5	350	95	27.1
Far East	1 008. 4	294	294	2.5
total	2 395. 1	852.4	160.2	18.8

Second, as a weak area of hydro-power in Russia, small hydro-power stations have been developed to a certain extent in recent years. While strengthening independent development of hydro power, Russia has also carried out extensive international cooperation. The Andalusian Electric Power Company and the World Wide Fund for Nature (WWF) have comprehensively studied the impact of the construction of hydro-power stations in eastern Russia on the local environment, and explored projects with minimal environmental impact and extremely high social and economic benefits. In 2014, Russia reached an agreement with China Three Gorges Group (CTG) and China Power Construction Group to develop hydro-power projects with flood control power generation and pumped storage functions in Russia. In the same year, it reached a cooperation agreement with China Power Construction Corporation to start the construction of the Leningrad Pumped Storage Power Station project with an installed capacity of 1,560 MW.^[3]

Third, the development of wind energy in Russia has unique factors. The first is the endowment of wind energy.

Russia has a large land area and rich wind resources. It is estimated that Russia's economic wind energy potential is 200 to 300 billion kW·h / a; Geographical conditions, because 's oil and gas resources are located in a relatively narrow and concentrated area, and transportation costs are high, wind power has become one of the important ways to solve energy supply problems.

Table2 Crude oil production in Russia in the last 10 years



However, the installed capacity of wind power in Russia has been maintained at 10 MW, and it has only made a breakthrough in 2015, increasing to 11 MW, and generating 6 GW·h in 2016. In recent years, Russia will develop and implement a series of wind power (WPP) projects with installed capacity ranging from 100 to 300 MW. If these projects are successfully implemented, the wind power installed capacity growth will undoubtedly be a leap. However, despite the good plan, the development of wind power projects in Russia is still slow in the short term. Industry experts and investors have expressed negative views on the Belorussian wind power industry.

In terms of wind power technology research and development, as early as the 1930s, Russia became the first country in the world to build utility-scale wind turbines. In 1995, Russia developed 250 kW vertical-axis wind power equipment. However, due to 's lack of wind power demand and development power, the total installed wind power capacity has not increased. Its research and development in wind power technology has a certain degree compared with Western European countries. gap. As countries around the world pay more and more attention to the development of wind power, has begun to actively develop wind power projects in recent years and develop wind power equipment, such as new high-torque wind turbines and small mobile wind turbines.

Third, with the world's largest land area, Russia has a unique advantage in the development of solar energy. Even if only 30% of the country's land can be used effectively, the potential for solar power generation is still huge, and its application prospects are quite broad. However, because the development and utilization cost of solar energy is 50% higher than that of fossil energy, if a balance between price and quality is found through policy-driven and technology-driven, which can reduce costs while ensuring efficiency, solar energy is bound to be in the Belorussian energy supply system. Occupies a place in.^[4]

Since 2012, solar power generation in Russia has seen substantial development. On the one hand, has accelerated the construction of local solar power stations. In August 2012, Russia decided to build a solar power station with an installed capacity of 100 MW in Chelyabinsk Oblast. At the same time, it also planned to issue a total of about 160 billion rubles through a bidding project selection mechanism. Subsidies for solar power generation. As of the end of 2016, 's solar installed capacity reached 540 MW, and it is expected to reach 2,000 MW by 2020. On the other hand, Russia is also actively seeking international cooperation in the construction of solar power plants. In 2012, Lukoil Petroleum Corporation launched a solar power project in Uzbekistan with a total investment of nearly 250 million euros, including solar power generation with an installed capacity of 100 MW. Station and Solar Energy Research Institute.^[5]

Table3 The unit of installed capacity development of Russia Energy Corporation: MW

2005	2006	2007	2008	2009	2010	2015	2020
7718.6	7713.3	7659.91	7728.9	7910	840.1*	9900*	11000*

Source: Ministry of Energy of Russia, Institute of Thermal Energy of Russia, Russia State Energy Corporation. Marked with * is the planned installed capacity

In addition, the geothermal power station on Kunashiro Island (one of the southern Kuril Islands) has been fully launched, which uses the steam pressure of Mendeleev Volcano to generate electricity. It is estimated that the power station can reduce the consumption of more than 4,000 tons of diesel or 7,000 to 10,000 tons of coal each year. Russia also plans to build a 30 MW geothermal power station on Zetra (one of the South Kuril Islands).

Russia's solid agricultural foundation and abundant forestry resources give it a huge potential for biomass fuel production capacity, but it has not yet been fully used. At present, and Ukraine jointly build an ethanol plant in Omsk, Siberia. In June 2011, China and signed a biomass energy cooperation framework agreement. In May 2013, issued a government decree that established a mechanism for promoting the development of renewable energy, but eliminated biomass energy and biogas power generation. Due to the lack of relevant incentive policies, the planned construction of a 580MW biomass power plant and a 330MW biogas power plant before 2020 may not be completed. Experts believe that most of the biomass and biogas power plants are located outside the coverage of the power grid, and the installed capacity is smaller than the scale of industrial production, so no relevant incentive policies have been issued this time. For biomass and biogas power plants that are planned to be launched, they can still receive price subsidies in the retail market after obtaining qualification certification through competition. However, it is unlikely that large-scale biomass and biogas power plants will be established before 2020.^[6]

2. Difficulties in the development of renewable energy in Russia

Russia's superior natural resources are fully equipped for the development of renewable energy, and show regional diversity. The economically exploitable amount of renewable energy in the Belorussian Federation exceeds 2.7 Tt standard coal, and there is huge development potential. Wind and solar energy can supply electricity to remote areas that cannot be reached by the power grid; vast forests and arable land can provide biomass energy; the North Caucasus and Kamchatka Peninsula can use geothermal energy; the eastern part of the river estuary, the White Sea and the Sea of Okhotsk Can develop tidal power generation. On the other hand, Russia has unique conditions for the development of a mixed supply of renewable energy and electricity. However, Russia's oil and gas resources have always been in a strong position, and its fiscal revenue is very dependent on oil and gas energy exports. The sufficient and cheap supply of fossil energy makes's development of renewable energy insufficient. In addition, energy prices and taxes in Russia are significantly lower than most countries in the world, and the price of gasoline is only 0.5%. Around US\$68/liter (August 2017), such low oil and gas prices make it difficult for renewable energy to form a price advantage, and it also increases the difficulty of government fiscal policy formulation. These unfavorable factors have caused a scarcity of talents in the field of renewable energy development.

Secondly, along with the tense relations between Russia and Western countries, the changes in the international energy landscape have had a profound impact on Russia's energy strategy. The success of the shale gas revolution in the United States has made it the largest natural gas producer over Russia since 2009, and natural gas production has increased year by year, reaching 749.2 Gm³ in 2016, which is 29.3% higher than 's 579.4 Gm³. This will compress expectations of Russiaian natural gas exports and is likely to force Russia to expand domestic gas demand.

Table 4 Natural gas production in Russia and the United States over the years

years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
United States	545.6	570.8	584	603.6	648.5	680.5	685.4	733.1	766.2	749.2	802.3
Russia	203	211	176	188.9	207	292.3	204.7	281.7	275.1	279.4	313.4

3. Renewable energy development countermeasures and prospects

First, develop a diversified model. In order to seize the strategic opportunity of the global energy revolution and promote the transformation of domestic energy production and consumption patterns, Russia should devote itself to the large-scale development, diversified development, distributed utilization of renewable energy, and equipment manufacturing and infrastructure. Technological innovation in facilities and other fields, to achieve the large-scale, diversified, and distributed development and utilization of renewable energy, thereby reducing investment and use costs, alleviating financial pressure, and improving the market competitiveness of renewable energy and equipment manufacturing to reduce The competitive disadvantages of traditional fossil energy sources even occupy a more favorable position in international competition and cooperation by owning independent intellectual property rights.

Second, build a reasonable policy system. At this stage, renewable energy is still a policy-oriented industry. The absence of systems, difficulties in implementing policies, overlapping content, and conflicting objectives have become major obstacles hindering the development of renewable energy in Russia. Russia has gradually realized that the comprehensive development and utilization of renewable energy requires a clear and complete legal framework and policy system. In the future, it should continue to promulgate and improve relevant laws, regulations and policies to realize the rationality and comprehensiveness of the system design for renewable energy development. And coordination.

Third, the development of an international capital model, capital and other production factors and international cooperation in scientific and technological research and development can optimize resource allocation, promote complementary advantages, increase market size, optimize utilization models, and reduce development costs. Russia's renewable energy resource endowment and late-coming trends determine that it should make full use of international cooperation agencies or mechanisms such as the "Belt and Road" Initiative, the BRICS, and the Shanghai Cooperation Organization to strengthen strategic cooperation with China and other countries, and introduce More advanced technologies attract more international investment. In addition, will also encourage more domestic energy companies and capital to enter the field of renewable energy, seek international cooperation, expand domestic and foreign markets, and gradually establish international multilateral cooperation mechanisms and models for renewable energy.

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4. Summary

Energy cooperation is an important foundation and support for the "Belt and Road" initiative, and the renewable energy industry, which is low-carbon and environmentally friendly, has huge reserves, and has high industrial relevance, is an important starting point for building a green "Belt and Road" initiative. At the same time, the "Belt and Road" initiative also provides an effective multilateral cooperation mechanism for energy cooperation among countries along the route. At the "Belt and Road" International Cooperation Summit Forum held in May 2017, my country proposed to seize the new round of energy restructuring and energy technology reform trends, build a global energy Internet,

and achieve green and low-carbon development. As a global renewable energy technology, equipment production and application power, my country has accumulated many advanced concepts and development experience in the field of renewable energy that are worth promoting or learning from, and has formed a certain industrial competitive advantage. China should combine these advanced concepts, development experience and advantages with the needs of countries along the “Belt and Road” to build a renewable energy system, and provide relevant countries with experience in the construction of legal and regulatory frameworks and policy formulation; in renewable energy technology International cooperation in industrial chain and demonstration projects with and other countries in areas such as research and development, personnel training, equipment manufacturing, energy storage, and smart grid construction; energy companies should be encouraged to plan development strategies, select partners, and integrate development from a global perspective Resources, make up for the lack of talents, capital, market, and technology, and achieve sustainable development.

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