“Prospects of Japan-Russia cooperation in wind energy”

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Abstract

The main objective of this study is to analyze and consider all the possible ways of cooperation between Russia and Japan in wind energy development and prove the statement that this cooperation is beneficial. Consequently, the authors try to show the possible spheres of collaboration between Japan and Russia in wind energy and to analyze an economic sense of this collaboration. Methodological basis of the study is comparative analysis of main features of Japanese and Russian wind energy markets. The authors are of the opinion that Japan-Russia cooperation in wind energy is beneficial due to the foreseeable gains for the countries. One of the possible ways of cooperation in wind energy development between Japan and Russia is installation of 30-50 MW wind energy electric stations on the basis of MWT100/2.4 and MWT102/2.4 wind turbines. Economically effective wind energy potential in Russia implies installation of 3062 of such turbines till 2020.

Keywords: renewable energy, wind energy, Japan-Russia cooperation, cooperation benefits, energy market in Russia.
JEL Classification: F49, F53.

Introduction

Nowadays, our world faces many serious political, social, economic and environmental challenges. Financial capital intensively changes countries' risks and spheres of development. A new sphere of economic relations with considerably higher level of world competition is forming now. Obviously, in these conditions, many countries are mostly dependent on their level of activity in the world cooperation and economic steadiness which, in turn, is based on diversification of economic relations.

Japan's economy plays an important role in the modern world. First of all, Japan is one of the most highly developed countries, one of the leaders in technological development and production of machinery and equipment. However, future of this country depends not only on the efficiency of the government policy, but also on the strategies of private companies in operating on the new markets and strengthening of cooperation with foreign partners in education, technological development and production. (Dechezlepretre & Glachant, 2013; Jordan-Korte, 2011; Taisuke & Hiranuma, 2009).

Today, a problem of energy recourses is extremely relevant for many developed economies such as Japan. This problem becomes more crucial as an inevitable result of growth of global production and consumption (Bruns, 2011). Ecological and global warming issues are stepping up and intensifying every year.

In this situation, development and production of alternative sources of energy become key tasks for economies with highly developed technological base.

We put forward the view that Japan has necessary potential to become one of the main centers of production of alternative energy equipment. Moreover, market of such equipment is still underdeveloped and has great growth perspectives (Dent, 2013).

It is obvious that developing counties which have an abundance of natural recourses also face many problems which could be settled by renewable sources of energy and the markets of these countries are also considerably promising (Hau & Von Renouard, 2006; Kempener, Anadon & Condor, 2010; Nikolaev, 2011; Ryzhenkov, Ermolenko & Ermolenko, 2011). In particular, the Russian market of renewable sources of energy has huge prospects.

Wind energy is one of the most promising forms of renewable energy today with an annual market growth of almost 10% (International Renewable Energy Agency [IRENA], 2013; Global Wind Energy Council [GWEC], 2013; Manwell, McGowan & Rogers, 2009). Russia is considered to have the biggest wind energy potential in the world while Japan has many political and economic incentives to cooperate with Russia in this important industry. In this sense, cooperation between these countries could generate great benefits for both sides.

The main objective of this study is to analyze and consider all the possible ways of cooperation between Russia and Japan in wind energy development and prove the statement that this cooperation is beneficial. In this research, we try to show the exact spheres of collaboration between Japan and Russia in wind energy and to analyze an economic sense of this collaboration.

1. Methodology

Methodological basis of the study is comparative analysis of Japanese and Russian wind energy markets. Russian market is analyzed in more detailed way to support the hypothesis about profitability of investment in Russian wind energy market for Japanese manufacturers.

First of all, we investigated the main features of production and consumption of electric energy in Russia. The government mechanism of energy renewable sources usage stimulation was also analyzed. For this reason, the most important eleven decrees of the government of Russian Federation were taken into consideration.

Further, wind energy potential in Russia was considered on the basis of economic efficiency of wind energy utilization in the particular regions where the prices of electric energy high enough to provide profitability of wind power plants.

Finally, Japanese wind energy market was compared to the Russian one on the basis of installed capacity and the main market manufacturers.

It is important to mention a few limitations of this study. Lack of reliable data required us to limit the scope of our analysis and the size of it. Further, lack of prior research studies on the topic of international cooperation in wind energy also limited the foundation of the research. Corresponding with this, there is a need for further research of this problem.

2. Literature review

Markets of electric power of different countries have many relevant differences (Khristova, E. & Meltenisova, E., 2014). However, most of scientific studies conclude that wind energy is a prospective and efficient source of renewable energy in the world. Consequently, wind energy development could be aimed at solving environmental problems (Sheffield, 2004). Nevertheless, Earnst W. Peterson's (1974) study concludes that the main problem of wind power use is economical extracting of this power.

Another study suggests that wind power will increase in importance as a future supplier of electricity. Moreover, in the next decades it is anticipated to replace fossil power to some degree. The study also says that by 2050 wind power will have a significant share of the global electricity market (Hedberg, Kullander & Frank, 2010).

In turn, Leithead in his paper "Wind energy" says that today wind energy is the most important renewable source of power. He also puts foreword the view that the price of wind energy is competitive with traditional means of electricity generation (Leithead, 2007).

Notably, in the study "Global Potential for wind-generated electricity" it is shown that Russia has the highest annual wind energy potential in the world (Lu, McElroy, Kiviluoma & Anderson, 2009).

It is noticeable that Japan has far more developed wind power industry but "2011-2012 world nuclear industry status report" states that disaster hit Fukushima Daiichi Nuclear Power Station on the 11th of March 2011 made substantial impact on public opinion regarding energy policy (Schneider, & Froggatt, 2012). Thus, the report also claims that climate change, resource efficiency and energy security are the main factors driving rapid development of renewable sources of energy. Additionally, the authors of this study say that introduction of financial support schemes by some governments will enable renewables to compete in many energy markets and this will decrease negative impacts on environment and provide diversification of energy supply. Such support will lead to the fall of renewable energy costs due to technological development and economics of scale. These effects had already resulted in the wind power sector which has seen significant declines in costs over the past decades (Schneider & Froggatt, 2012).

It is important to underline that cooperation is "a sound method for developing solutions" (DeMarco, 1974). Moreover, Milner in her paper "International theories of cooperation among nations" argues that collaborative activity is primarily aimed on experiencing economic gains by cooperating countries (Milner, 1992).

Another research named "International research collaboration" supports that the writing of research findings is the most obvious and easily measured form of international collaboration (Frame & Carpenter, 1979). This leads to the point that wind power cooperation between countries should also have a scientific sense.

Finally, it is worth mentioning that energy is the most important way of cooperation between Russia and Japan. However, this cooperation mainly takes place in fossil fuels industry while renewables did not get enough attention (Buszynski, 2004). Nonetheless, unequal levels of development of the countries' renewable energy sectors, especially wind energy ones, define this direction of collaboration.

3. Analysis of production and consumption of electric energy in Russia

Russia is one of the biggest producers of electric energy. The modern power complex of this country consists of almost 700 electric power stations with capacity of more than 5 MW each. Cumulative capacity of electric power stations is higher than 220,000 MW. The structure of the electric power stations is as follows: 67.76% of thermoelectric power stations, 15% of hydroelectric power stations and 17.19% of nuclear power plants (Ministry of Energy of the Russian Federation [MERF], 2012).

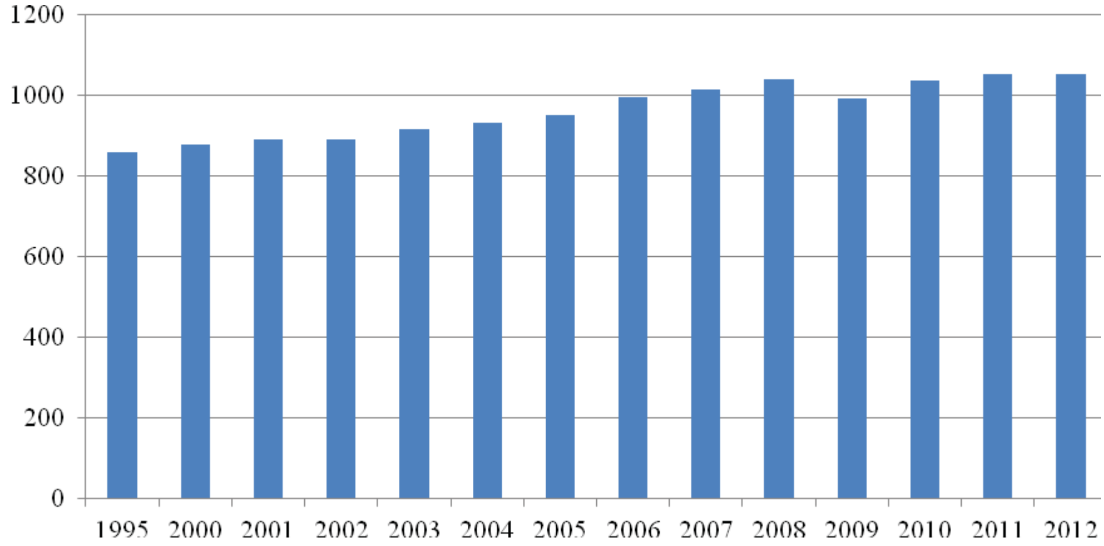

Fig. 1. Dynamics of electric energy production in Russia (million MW) (Federal Agency of Government Statistics of Russia, 2014)

Electric power is one of the basic branches of Russian economy. Electricity for companies and population is provided mostly by government organizations. In 2012, about 1053.4 billions of kWh of electricity were produced. In fact, for the past seventeen years eclectic energy production has experienced a dramatic growth of 22.5%. Nowadays, cumulative capacity of the United Eclectic Power System of Russia equals 223,070.83 MW.

Siberian Federal District consumes the highest volume of electricity which is almost 22% of total electric power consumption in Russia.

In Russia, the price of electric energy for consumers was about USD 0.0612 per 1 kWh in April, 2014. The highest price of 1 kWh of electricity exists it the following territories: Chukotka Autonomous Okrug (USD 0.1373), Magadan Oblast (USD 0.1129), Kamchatka Krai (USD 0.1081), Sakhalin Oblast (USD 0.0946), Moscow City (USD 0.0884), Sakha Republic (USD 0.0842). The lowest price of electricity is in Irkutsk Oblast: 1 kWh costs USD 0.023[1].

As for the country's wholesale and retail markets of electric energy, they are comparatively developed but not completely formed. The wholesale market operates within the boundaries of the country's market excluding isolated energy systems. Competitive market mechanisms such as long-term and mid-term agreements also take place (MERF, 2012). Spot markets have futures based on the price of electric energy in hub.

It is necessary to mention another key feature of the Russian eclectic power market. Consumers have an ability to choose a company of electric energy. It is clear that electricity prices of the retail market are dependent on prices of the wholesale market.

There are also "nonprice zones" where the structure of generation and distribution of electricity does not let to organize full market relations. Far East, Kaliningrad Oblast, Komi Republic and Arkhangelsk Oblast are considered to be such zones where market forces are not well in place.

On the retail market, the main subject is a supplier – organization which purchases electricity on the wholesale market and sells it to retail consumers. And electricity is supplied on the terms of the regular tariff.

Notably, on the wholesale market, the government mechanism of stimulation of usage of renewable sources of energy is implemented. A particular quality of this mechanism is that price of suppliers are regulated by the government. If necessary requirements are realized, the price is fixed on the level which compensates capital costs, maintenance costs and wealth tax (Decree 449, 2012).

4. A potential of wind energy development in Russia

Ministry of Energy of the Russian Federation provides data which states that technical potential of wind energy in Russia exceeds forty billions of kWh annually which constitutes approximately 3.8% of total volume of electricity produced (Manwell, McGowan & Rogers, 2009; MERF, 2012).

[1] Calculated by the author based on FAGSR (2014).

By 2030, an economic potential of wind energy in Russia is expected to reach the figure of 80-85 billions of kWh if there is an efficient legal base created for regulating relations between market participants. The aforesaid volume of wind energy would provide more than 5.5% of total electric energy produced (Nikolaev, 2011).

Russia's installed wind power capacity was about 16.5 MW in 2012 with annual cumulative manufacture of 25 millions of kWh which constitutes 2.4% of total electric energy production. At the end of 2013, the cumulative installed capacity of the country's wind power increased to 17 MW (The Wind Power, 2014).

Unfortunately, the country's wind energy sector is severely underdeveloped. The majority of the wind power capacity comes from small wind farms that dominate the market. Nevertheless, Russia has the longest coastline in the world with huge wind energy potential.

The greatest wind energy potential is allocated on the costs of the Pacific Ocean and the Arctic Ocean, the mountains of the Caucasus, the Urals, the Altay Mountains and the Sayan Mountains.

In Russia, development of wind power is considered in the context of the renewable energy utilization government program and it is one of the country's energy policy most important directions. Corresponding with this, Energy Strategy of Russia for the period till 2020 is focused on making renewable source of electric energy equal to 4.5%. Renewable electric energy production targets are presented in the table below (Decree, 2012; Decree, 2013; Ministry of Economic Development of the Russian Federation, 2013).

Table 1. Russian renewable electric energy production targets

	2010	2015	2020	2030
Share of renewable sources of energy in electricity generation	1.5%	2.5%	4.5%	More or equal than 4.5%

Source: Ministry of Economic Development of the Russian Federation, 2013.

In the areas of wind energy development, the wind farms electricity prime cost should be 18% lower than the prime cost of electricity of new natural gas and coal electric power stations. The favorable districts of allocation and the possible volumes of of wind power stations utilization till 2020 are presented in the bar chart below (Nikolaev, 2011).

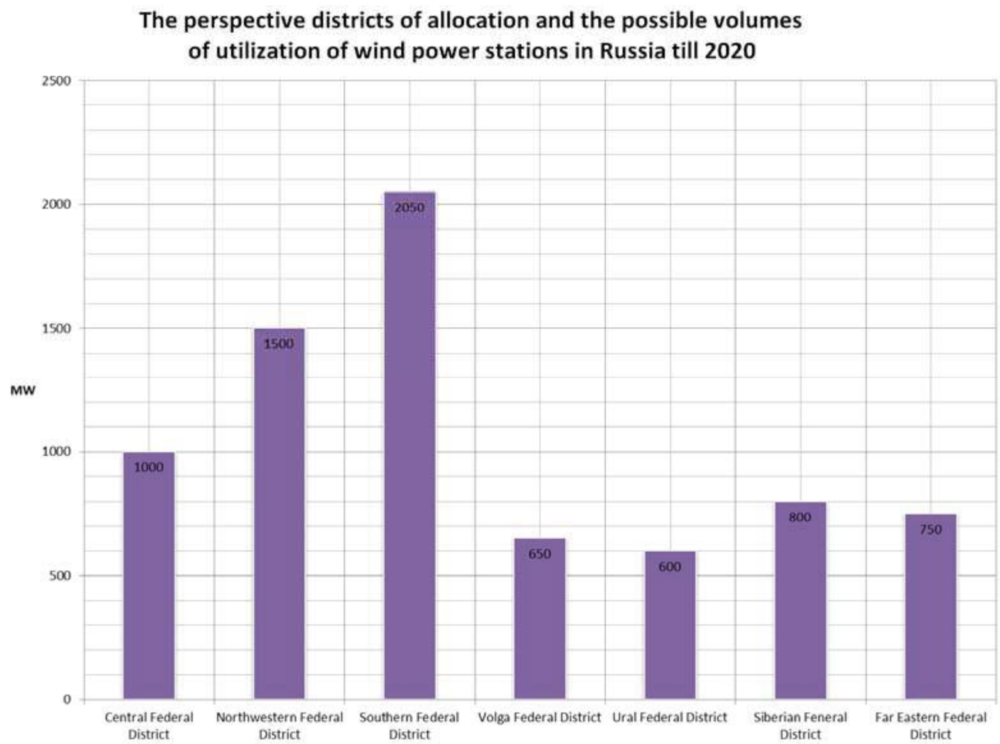

Fig. 2. The favorable districts of allocation and the possible volumes of utilization of wind power stations in Russia till 2020 (Nikolaev, 2011)

Taking into account the world experience, 30-50 MW wind energy electric stations on the basis of modern 2-3 MW wind turbines are the most energetically and economically effective in Russia (Nikolaev, 2011).

By 2030, the government is anticipated to construct wind plants with capacities of more than 100 MW in the following territories: Kaliningrad City (WEPS-1), 200 units of wind turbines, Ust-Luga City (WEPS-2, 300 units), Lodeynoe Village (WEPS-3, 300 units), Murmansk Oblast (WEPS-4, 500 units), Moscow Oblast (WEPS-5, 100 units), Nizhny Novgorod Oblast (WEPS-5, 350 units), Orenburg City (WEPS-7, 350 units), Saratov Oblast (WEPS-8, 1000 units), Astrakhan City (WEPS-9, 100 units), Volgograd Oblast (WEPS-10, 900 units), The Republic of Kalmykia (WEPS-11, WEPS-12, 450 units), Krasnodar Krai (WEPS-13, 1000 units), The Karachay-Cherkess Republic (WEPS-14, 300 units), Omsk Oblast (WEPS-15, 110 units), Primorsky Krai (WEPS-16, 100 units) (Decree, 2010-2013).

As regards the main wind turbine manufacturers of the market, Vestas dominates in terms of number of installations and total installed capacity. The largest producers of the wind turbines installed in Russia are presented in the table below (The European Wind Energy Association [EWEA], 2013).

Table 2. Top 7 wind turbine manufacturers of the Russian wind energy market

Manufacturer	Number of installed turbines	Total installed capacity (MW)	Market Share, %
Vestas	20	4.5	26
AVE	10	2.5	15
Vensys	2	2.4	14
Hanseatische AG	4	2.2	13
Raduga	6	1.5	9
Micon	4	1.0	6
Wind World	1	0.6	3

Source: EWEA, 2013.

Russian Association of Wind Power Industry considers 14% return to be optimal for Russian wind energy market. However, in most cases the government should subsidize wind energy developers in the country. The main wind energy developers are presented in the table below.

Table 3. Top 7 wind turbine manufacturers of the Russian wind energy market

Company	Total installed capacity in MW
Kaliningrad Generation Company JSC	5.1
Chukotkommunhoz JSC	2.5
Bashkirenergo	2.2

Source: EWEA, 2013.

Thus, wind energy market in Russia is underdeveloped. However, there is an evidence to suggest that the country's wind energy sector is extremely promising for development and has many chances to become the biggest in the world.

5. Incentives of Japanese companies to invest in Russian wind energy market

Japan's cumulative installed capacity of wind power generation at the end of 2013 was about 2,661 MW (1,922 units on 414 wind farms). From the table below, it can be seen that Japanese manufacturers lag behind of European firms in the Japanese wind energy market. This is caused by the fact that the domestic market is not big enough for Japanese companies (Japan Wind Power Association [JWPA], 2013).

Table 4. Top 13 market shares in Japan by manufacturers

Manufacturer	Country	Market share, %
Vestas+NEG-Micon	Denmark	24
GE Wind Energy+TACKE	USA	19
Mitsubishi Heavy Industries	Japan	13
Enercon	Germany	11
Japan Steel Works	Japan	8
Siemens+Bonus	Denmark	5
Repower	Germany	5
Gamesa	Spain	4
Lagerwey	Netherlands	3
IHI-NORDEX	Japan+Germany	3
Fuji Heavy Industry	Japan	2
Ebara-Pfleiderer Wind Power	Japan+Germany	1
DeWind	Germany	1

Source: EKNT, 2012.

We suppose that investment in Russian wind energy sector is one of the most effective ways for Japanese wind energy industry to become more competitive and therefore to get the biggest share of their local market due to an economies of scale effect. Moreover, geographical proximity of the countries means lower costs of installation of wind farms by Japanese manufacturers.

Mitsubishi Heavy Industries (MHI) is the biggest Japanese manufacturer of wind turbines (Embassy of Kingdom of the Netherlands in Tokyo [EKNT], 2012). In this sense, MHI has an advantage to expand on the Russian wind energy market.

Table 5. Top three Japanese manufacturers

Manufacturer	Cumulative installation, MW	Market share, %
Mitsubishi Heavy Industries	322	13
Japan Steel Works	210	8
Fuji Heavy Industries	57	2

Source: EKNT, 2012.

It was previously mentioned that 30-50 MW wind energy electric stations on the basis of modern 2-3 MW wind turbines are the most energetically and economically effective in Russia. In this reason, there are at least two models of the new wind turbine generators of MHI that can serve as a basis of wind plants in the aforesaid Russian territories. These models are: MWT100/2.4 and MWT102/2.4.

The expected cumulative volume of utilization of wind power stations can reach 7350 MW in 2020. So, the wind farms, which are based on the wind turbines with the MWT100/2.4 and MWT102/2.4 generators, can include about 3062 of such wind turbines in total.

Installation of the 30-50 MW wind energy electric stations by Mitsubishi Heavy Industries on the basis of wind turbines with the MWT100/2.4 and MWT102/2.4 generators in Russia till 2030 is one of the best ways of long-term Japan-Russia cooperation in wind energy.

So, Japanese companies' investment flow to the Russian wind energy sector will create benefits for both Russia and Japan.

6. Cooperation between Japanese companies and Russian universities in research, creation and development of technologies of wind power

It is evident that scientific collaboration in the concerned sphere is important for both countries.

This kind of cooperation has already been realizing. A good example is that WINPRO Company of Japan and scientists of the Far Eastern Federal University (FEFU) of Russia began creation and development of new types of wind power plants which are able to operate at low temperatures in the Russian Far East. This region is considered to be one of the most profitable since wind energy use allows a significant reduction in costs due to high prices of coal and natural gas in this area (Vorotnikov, 2014).

The research started at the beginning of 2014. The goal is creation of small and medium wind plants. WINPRO is going to launch the technology in Primorky Krai within a few years (Vorotnikov, 2014).

Conclusion

As was mentioned, there are many scientific studies showing that wind energy is a prospective and efficient source of renewable energy. Wind power utilization will increase and it will play an important role as an electricity supplier (Hedberg, Kullander, & Frank, 2010). Furthermore, after experiencing a dramatic decline in costs, wind energy became competitive source of electricity (Leithead, 2007). Corresponding with this, wind energy development should be aimed at solving environmental problems (Sheffield, 2004).

Russia has the highest annual wind energy potential in the world (Lu, McElroy, Kiviluoma & Anderson, 2009). As for Japan, it has far more developed wind power industry. But after Fukushima disaster the country realized importance of renewable energy development (Schneider & Froggatt, 2012).

Today energy is the most important sphere of cooperation between Japan and Russia. Nevertheless, this cooperation mainly takes place in fossil fuels industry while renewables development does not have enough attention (Buszynski, 2004). But unequal levels of development of the countries' renewable energy sectors imply this direction of collaboration.

Thus, we support that there are two main ways of Japan-Russia cooperation in wind energy.

The first way is cooperation between Japanese wind turbine manufacturers and Russian government and private companies. The second one is cooperation between Japanese universities and companies and Russian universities in research, creation and development of technologies of wind power.

There are expected benefits of the cooperation for Russia such as decrease of carbon dioxide emission and creation of new work places. Furthermore, increase of competition on the electric energy market will cause decrease in prices of electric energy. As regards Japan, its manufacturers of wind turbines will experience economies of scale effect resulted from expansion on the Russian market. This can lead to increase in market capitalization of the manufacturers. So, we put forward the view that Japan-Russia collaboration in wind energy is beneficial due to the foreseeable gains for the countries.

Implications

We suppose that one of the possible ways of cooperation in wind energy development between Japan and Russia is installation of 30-50 MW wind energy electric stations on the basis of MWT100/2.4 and MWT102/2.4 wind turbines. Economically effective wind energy potential in Russia implies installation of 3062 of such turbines till 2020.

However, the existing legal base in Russia is not sufficient enough for the full use of wind energy potential. The government should modernize the wind power developers support scheme and provide the minimum of 14% rate of return on investment in wind power by subsidizing developers.

It was mentioned that by 2030, an economic potential of wind energy in Russia is expected to reach the figure of 80-85 billions of kWh. It means that such volume of wind energy would provide more than 5.5% of total electric energy produced in the country (Nikolaev, 2011).

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