Planning issues of wind farms siting in Russian Federation

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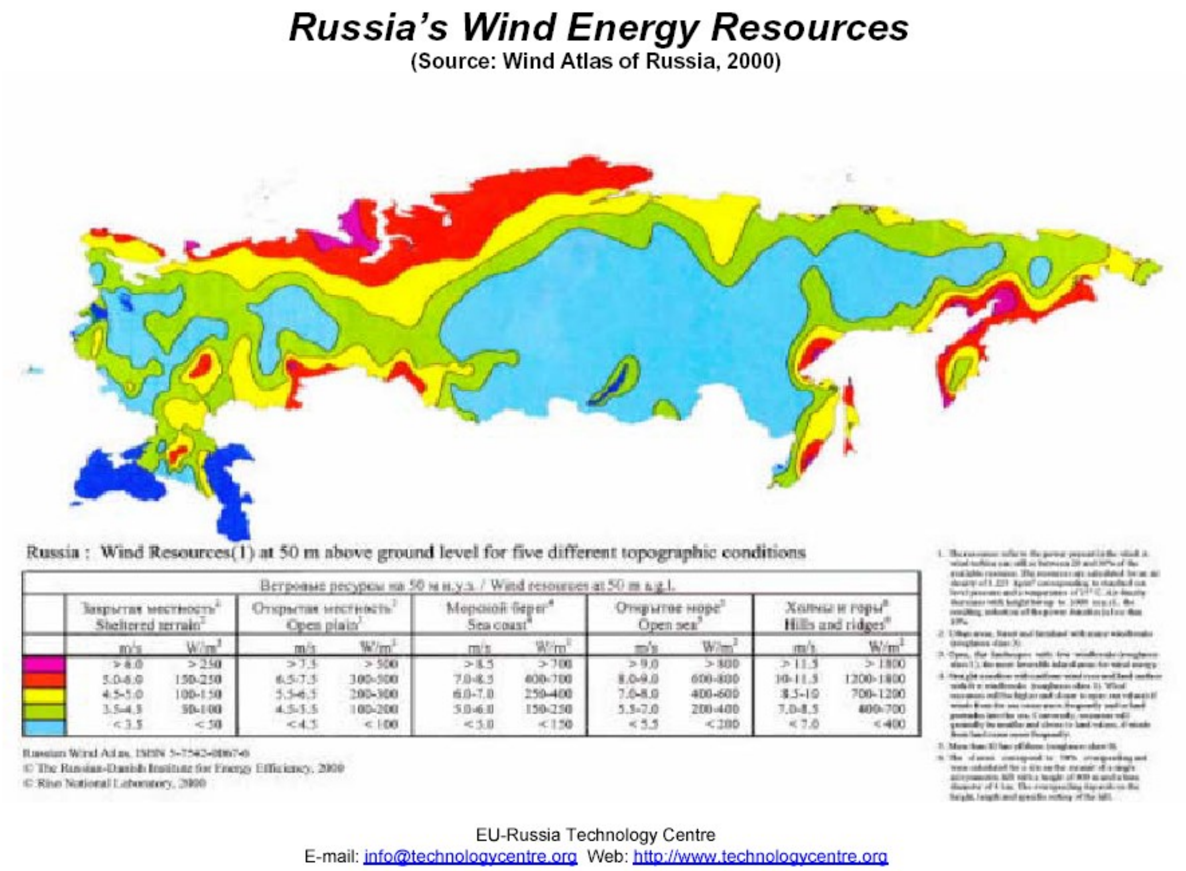
1. Introduction

Russia as a country with the largest territory in the world and one of the longest coastlines has enough suitable locations for siting onshore, nearshore and off-shore wind farms. Wind power potential of Russia is estimated at 16’500 TW.h/year [1]. Although these opportunities do exist, the Russian Federation is strongly bound to fossil fuels both in the internal economic development and in import-export balances.
Despite huge wind resources and governmental support, national plans for wind energy are modest. Based on the National Energy Strategy of Russia till 2035 and current trends, the International Renewable Energy Agency (IRENA) [2] predicts up to 5% of total energy demand to be covered by renewable sources, the installed capacity of solar power plants by 2030 – to be only 2.7 GW, and wind power stations – 5 GW. For comparison, US government reports estimate wind power to contribute up to 20% of national electricity supply by 2030 [3]. WindEurope’s Central Scenario assumes to get a 30% share of EU’s power demand from wind power [4].
At the same time, the Russian Federation is considered to be one of the world’s leaders in carbon dioxide emission with 5% share in 2014 [5]. Even so, Paris agreements, calling for 25% to 30% emission reductions below 1990 levels by 2030, were not ratified by Russia [6].
This article discusses the constraints on the way to provide better conditions for wind farms’ construction, looking for necessary improvements in Russian national policy, planning system and land use operational mechanism.

2. National context

2.1 Wind resources

Starkov et al. (2000) developed Russian Wind Atlas, where wind energy resources are studied.



Ветровые ресурсы на 50 м н.у.з. / Wind resources at 50 m a.g.l.										
	Закрытая местность / Sheltered terrain		Открытая местность / Open plain		Морской берег / Sea coast		Открытое море / Open sea		Холмы и горы / Hills and ridges	
	m/s	W/m²	m/s	W/m²	m/s	W/m²	m/s	W/m²	m/s	W/m²
	> 6.0	> 250	> 7.5	> 500	> 8.5	> 700	> 9.0	> 800	> 11.5	> 1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0-8.5	400-700
	< 3.5	< 50	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 7.0	< 400

Figure 1 : Russia's wind resource map (source: Russian Wind Atlas)

The areas of greatest wind resource are the regions where the population density is less than 1 person per km2 [7] The coastal areas of the Pacific and Arctic Oceans, the vast steppes and the mountains are the areas of highest potential. Recent estimates suggest that the European part of Russia has a gross wind energy resource of 29 600 TWh/yr (37%) and the Siberian and Far East part, 50 400 TWh/yr (63%). The technical resource for each is reported to be 2'308 and 3'910 TWh/yr, respectively.

It has been suggested that large-scale wind energy systems might be applied in areas where the resource is particularly favourable and there is an existing power infrastructure and major industrial consumers. These would include various locations in Siberia and the Far East (east of Sakhalin Island, the extreme south of Kamchatka, the Chukotka Peninsula in the Magadan region, Vladivostok), the steppes along the Volga river, the northern Caucasus steppes and mountains and the Kola Peninsula. Additionally, offshore wind parks could be considered in some of these areas, especially in the Magadan region and in the Kola Peninsula where existing hydropower stations could be used to compensate for the intermittent wind power.

The Russian Association of Wind Industry (RAWI) has stated that as at March 2010, 4'134 MW of wind capacity sites had been identified.

Breyer et al. [8] created a computer model, which considers the energy costs of various types of renewable sources, and marked the optimal kind of renewable source according to its regional potential. This strategic choice was offered for a long-term path to a completely renewable energy power supply.

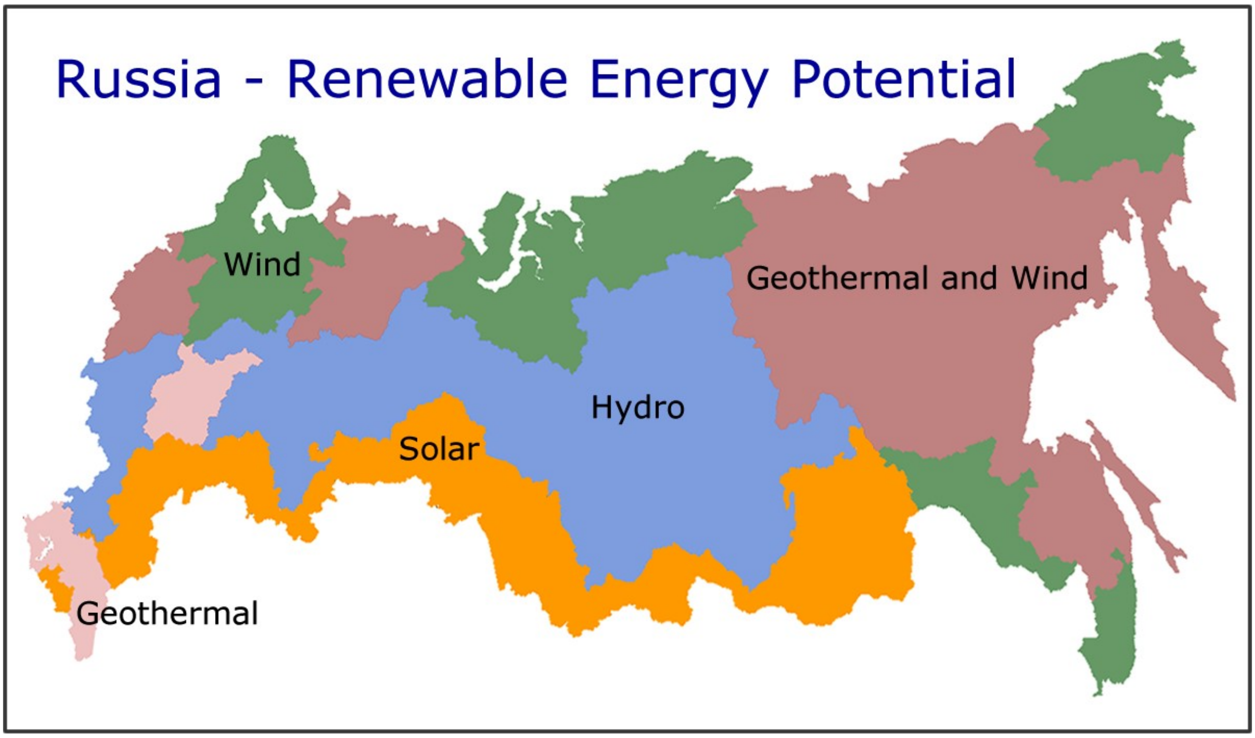


Figure 2 : Russian renewable energy potential (source: Bogdanov, D., Breyer, C. [9])

2.2 Current power production

The total power capacity in Russia currently equals 239.8 GW, while wind power annually produces 96.71 MW, which is less than 0.05%. The Unified Energy System of Russia includes 748 power plants with a capacity of over 5 MW and generates about one trillion kWh of electricity per annum.

Table 1 : Power output and consumption in Russia (2017) (source: System operator of the Unified energy system http://so-ups.ru/)

№	Parameter	millions kW h	%
1	Output	1053861,5	100,00%
a	- thermal power plants	611341,5	58,01%
b	- hydroelectric power stations	178901,6	16,98%
c	- nuclear power plants	202642,4	19,23%
d	- others	60976	5,79%
2	Consumption	1039879,9	98,67%

Energy deficit regions are mostly located in the southern part of Russia (deep in the Eurasia continent), what makes land-based wind farm more relevant (see Fig. 3).

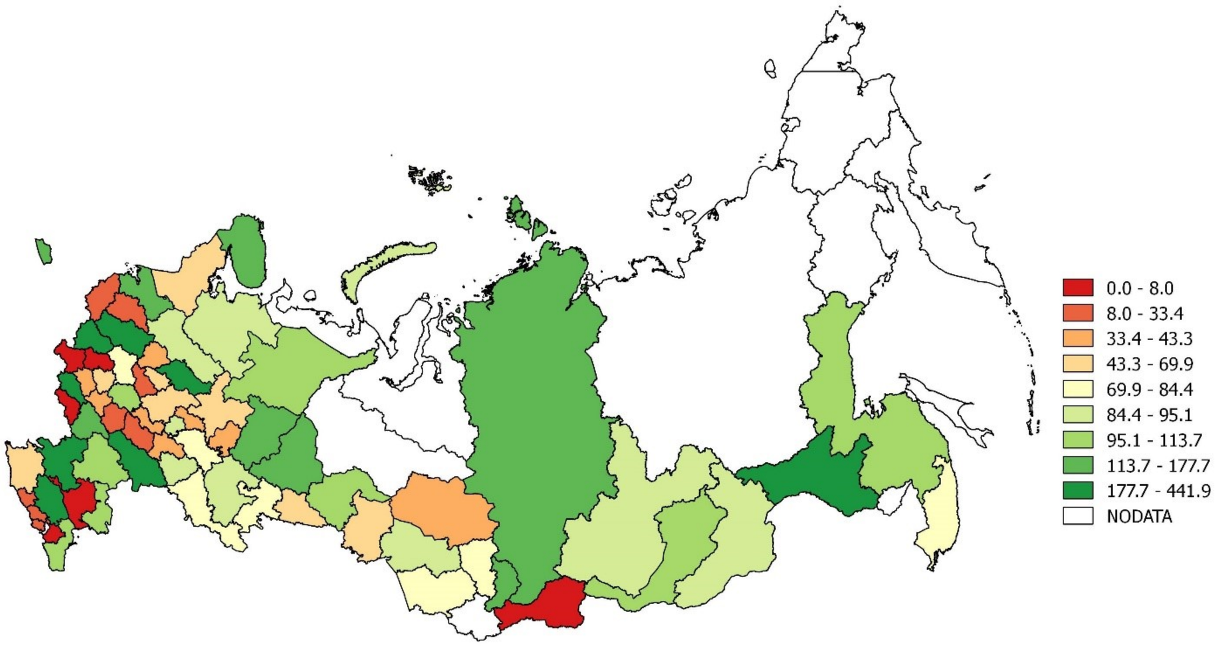


Figure 3 : Map of power production divided by power consumption (per cent) for each region in Russia (2017). Green regions are «power donors», red regions are «power recipients». (source: made by author)

Wind power stations and projects of planned wind farm construction are distributed unevenly (see Fig. 4).

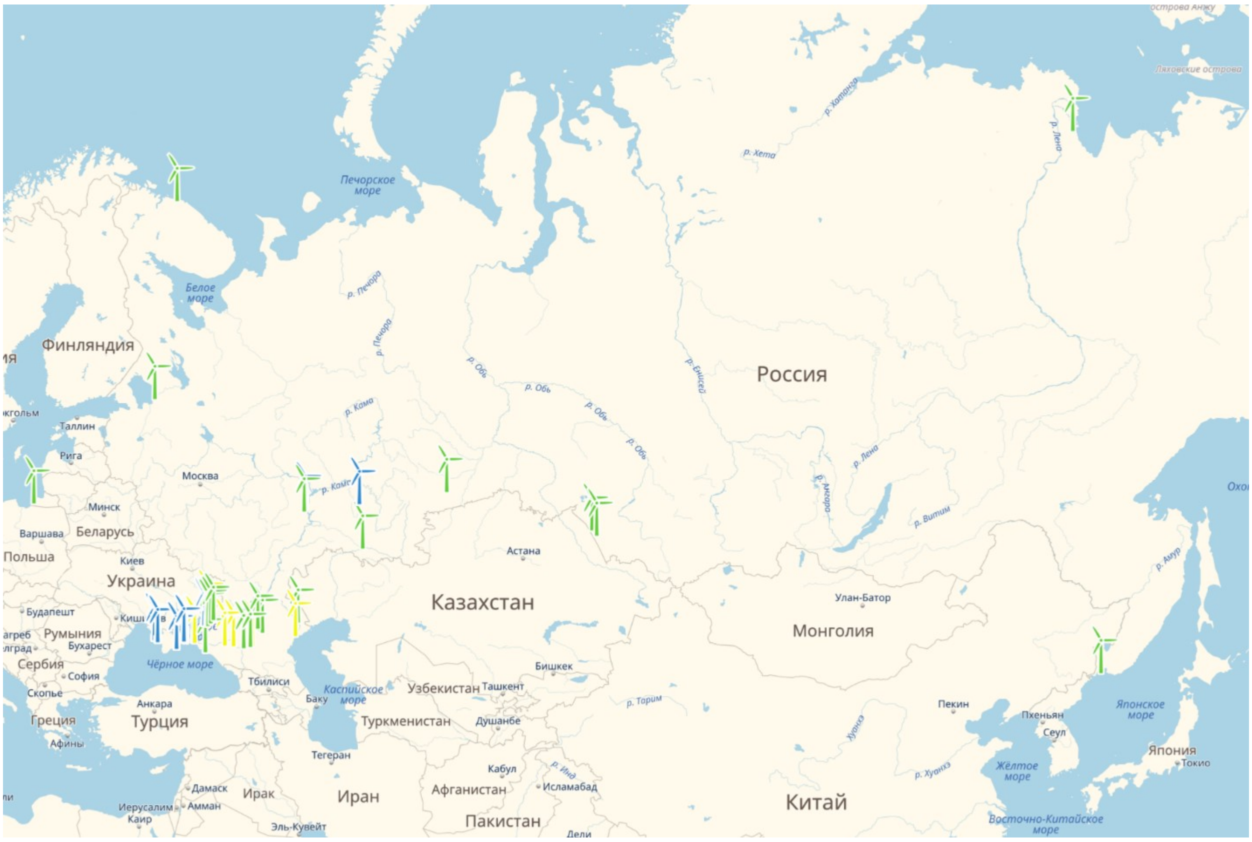


Figure 4 : Map of wind energy projects in Russia. Yellow – wind monitoring stage, Green – design stage, Blue – exploitation stage. (source: Russian Association of Wind Industry, RAWI https://rawi.ru/ru/map18/)

According to the RAWI data, there are 8 existing wind farms in Russia.

Table 2 : Wind power stations in Russia (source: Russian Association of Wind Industry, RAWI)

№	Name of the wind farm	Region	Installed capacity, MW	Year of completion
1	Ulyanovsk wind farm	Ulyanovsk region	35	2018
2	Tyupkildy wind farm	Republic of Bashkiria	1,65	2001
3	Presnovodnenskaya wind farm	Republic of Crimea	7,39	2006
4	East Crimean wind farm	Republic of Crimea	2,81	2009
5	Sudak wind farm	Republic of Crimea	3,76	2001
6	Sakskaya wind farm	Republic of Crimea	20,82	1998
7	Donuzlav wind farm	Republic of Crimea	6,78	1992
8	Tarkhankut wind farm	Republic of Crimea	18,5	2001

Total installed capacity of wind farms in the Republic of Crimea is about 64 MW, but all of them were commissioned before 2014, when the Russian Federation began to consider Crimea to be a part of its territory.
The energy infrastructure of isolated regions is based on a stand-alone power supply ("off-grid") mainly consisting of diesel power plants with one or more diesel generators. The number of diesel generators in these isolated areas is about 900; diesel power plants produce about 2.5 billion kWh, which equals the consumption of approximately 1 million tons of diesel fuel per year (to substitute diesel power completely with wind power would require a wind capacity of 1000-2000 MW plus storage, depending on the specific sites.) There are cross-subsidization in these regions and procedures how to cover the difference between the real generation costs (up to 2.5 $/kWh) and the actual rate for the customers (3-4 cent/kWh) have not been worked out yet [Elistratov et al., 7].

Table 3 : List of stand-alone wind-diesel hybrid energy systems in Russia (source: Elistratov et al.)

Location	Wind	Diesel
The Bering Island (Kamchatka)	550 kW (2 Vergnet GEV-C with unit capacity of 275 kW)	1168 kW
The Ust-Kamchatsk village (Kamchatka)	first stage: 1 Vergnet GEV-C (capacity of 275 kW in the version for cold climates); second stage: 3 wind turbines Komai KWT 300 (unit capacity of 300 kW)	8 MW
The Novikovo village (Sakhalin region)	450 kW (2 turbine with unit capacity of 225 kW)	N/a
The Republic of Tatarstan	Ghrepower FD 12-30/11 (30 kW)	N/a

The Amderma village (Nenets Autonomous Okrug)	200 kW (4 arctic version turbines Ghrepower-50 with unit capacity of 50 kW)	800 kW

2.3 Legislation

Russian government made first steps to support the development of wind and renewable energy, codified in the amendments of 4.11.2007 in the Federal Law of 26.03.2003 № 35-FZ “On Electric Power Industry”1 . Based on that Law, the Non-profit Partnership “Council for Organizing Efficient System of Trading at Wholesale and Retail Electricity and Capacity Market” (“NP Market Council”) was established. This organization, on a membership basis, brings together electricity sellers and buyers that are wholesale market entities (including renewable energy and wind power) taking part in the circulation of electric power on the wholesale market. It also pairs up companies operating the commercial as well as technological infrastructure of the wholesale market and other companies of the electric power industry.

The Government Decree of 28.05.2013 Nr. 449 “On the mechanism of promoting the use of renewable energies in the wholesale electricity market and power” was approved as another important step: A requirement for mechanisms was introduced to work with renewable energy projects in the wholesale electricity market, including regulations to develop renewable energy until 2020.

The development of renewable energy in the retail market of Russia is carried out in accordance with the programs of the energy efficiency in these regions, and the local authorities are taking over the role of the “NP Market Council”, e.g. by organizing tenders. The main documents in the retail market are the Government Resolution of 04.05.2012 Nr. 442 (ed. on 10.11.2016) “The rules of functioning of retail electricity markets” and the Federal Law of 23.11.2009 Nr. 261 “The improvements on energy saving and energy efficiency in the retail market” (energy service contracts). In addition, there are local energy efficiency laws in some isolated regions.

2.4 Support from the government

Wind energy like other renewable energy sources is legislatively supported in Russia since the May of 2013. The goal of support is not a replacement of traditional generation (based on natural gas, oil, coal, etc.) with renewable sources, but the development of new power generation technologies. The support is provided both in the wholesale and retail energy markets.

Legislative support of renewable energy sources includes following privileges:

- power produced by wind farms over 25 MW is totally purchased during 15 years at a fixed price plus 12% profit for investor;
- the fixed price takes into account fluctuations in the exchange rate, the actual value of the project's capital expenditures, other parameters.

According to the Government Decree №449, 3.35 GW of installed capacity will be installed by 2024 – 4.5 GW in 2030.

Table 4 : Installed capacity of the wind farms to be supported according to the current program for each year (source: the Government Decree №449)

Year	2017	2018	2019	2020	2021	2022	2023	2024
Capacity, MW	200	400	500	500	500	500	500	150

Main conditions for obtaining the support are:

- the maximum of capital expenditures (CAPEX) for wind power projects is determined (for example, in 2016 it was 152’000 roubles for 1 kW);
- localization principle - wind farms built in Russia should use equipment and services, produced in Russia. If a wind farm is commissioned after 2019, then localization rate has to be 65% or more.

Energy projects based on renewable energy sources are being held for a contract for the supply of capacity (CSC) as a legal form of the support mechanism. The selection of wind farm projects is held every year for the upcoming 4 years. The CAPEX is the main criterion: the smaller the CAPEX is, the more likely to win.

Table 5 : Wind power projects selected for the wind energy supply since 2013 till 2016 (source: https://www.atsenergo.ru/vie/proresults)

№	Year of the selection	Name of the wind farm	Region	Installed capacity, MW	Date of completion (plan)	Date of completion (fact)
1	2013	Aksaray wind farm, Funtovo wind farm,	Astrakhan Region	15 + 15 =30	2016, 2017	uncompleted
2	2013	Airport wind farm, Novosergievskaya wind farm	Orenburg region	15 + 15 = 30	2017	uncompleted
3	2013	Karsun, Isheevka, Novaya Maina wind farms	Ulyanovsk region	15 x 3 = 45	2017	uncompleted
4	2014	Priyutnenskaya wind farm, 1 stage	Republic of Kalmykia	51	01.12.2015	uncompleted
5	2015	Ulyanovsk wind farm	Ulyanovsk region	35	01.12.2016	01.2018
6	2016	Pilot wind farms	Krasnodar region	20 MW x 23 = 460	10 in 12.2019 13 in 12.2020	is being implemented
7	2016	Shovgenovskaya wind farm	Republic of Adygea	48 + 70 + 32 = 150	01.12.2018	is being implemented

Thus, only one of the 9 wind farms, which should have been completed by today, is really built. But even it was built 2 years later.

Speaking about projects, the implementation period of which is known, but has not yet come, in 2017, projects with a total capacity of 1.65 GW were selected, including 924 MW in the southern regions. And in 2018, projects with a total capacity of 853 MW were selected, including 588 MW in the southern regions. This distribution follows the energetic deficit in southern part of Russia, which was described earlier.

2.5 National planning

At the same time, Scheme of territorial planning of the Russian Federation at the field of power engineering, STP RF PE (national level planning document) plans 15 wind power plants to be sited in different regions till 2030 with total installed capacity over 4500 MW.

Table 6 : Wind farms planned for construction until 2030 (source: STP RF PE)

№	Region	Installed capacity, MW
1	Kaliningrad region	200
2	Leningrad region	300
3	Murmansk region	300
4	Murmansk region	100
5	Nizhny Novgorod region	350
6	Orenburg region	150
7	Saratov region	1000
8	Astrakhan region	100
9	Republic of Kalmykiya	150
10	Krasnodar region	1000
11	Republic of Adygeiya	195
12	Republic of Adygeiya	102
13	Republic of Adygeiya	144
14	Karachay-Cherkess Republic	300
15	Omsk region	110
	Total	4501

The most ambitious wind power projects (1 GW each) are planned in Saratov region and in Krasnodar region. As it was shown earlier, Krasnodar is the second most energy deficit region in Russia after Moscow, so the decision seems reasonable. But Saratov is the biggest energy donor in the country, which generates three times more then uses for internal needs. It makes the distribution of future wind farms questionable.

3. Challenges and constraints of wind power development

Most common constraints of wind power projects discussed by researchers in different countries are:
- environmental impact;
- territorial requirements:
- amount of land;
- configuration of parcels;
- landscape conditions;
- temporary and permanent land uses;
- distance to residential zones;
- complications for agriculture;
- volatile power supply by wind farms and the necessity of storage infrastructure;
- social acceptance;
- lack of properly adjusted law.

Based on stakeholders' interviews Gsänger and Denisov [10] outline main barriers for the Russian wind power industry:
- a general lack of investments and investors which is primarily related to an insufficient and intransparent remuneration scheme and the small market volume but also to the macroeconomic situation in the country.

- a significant number of weaknesses in the regulatory framework, including land use issues, standards etc.
- challenges with grid connection.

In a sense, all of the above constraints can be connected to the planning process, that's why we will study them more.

3.1 Environmental impact

Although wind power is considered to be one of the cheapest renewable energy sources (by levelized cost of energy – LCOE [11]), it doesn't mean that energy production became completely harmless for the natural environment. To avoid these risks a relevant site-specific research should be conducted before siting a wind farm.
Often this impact is shown through the bird migration processes [12, 13]. Wind turbines' sweep of the blades can reach up to 200 meters, what can potentially be catastrophic for birds' population.
Wind turbines are also criticised for its noise. Latest studies show that noise level of modern wind power plants is usually 35-40 dB(A) [14], what people still find annoying. Prescribed minimum sanitation distances from a wind turbine to residential zones and houses can make a certain difference for planning practice and controls over the urban sprawl.

3.2 Territorial requirements

As wind turbines are most effective in a certain distance one from another, wind farms in total need many hectares of land. Land (on average 34 ha/MW of total project area - according to Denholm et al., 2009) is needed for permanent and temporary use and the required area depends mostly on the number of turbines, their installed power and their configuration in space.
Configuration of wind plant for land use planning purposes was divided by National Renewable Energy Laboratory (NREL) [15] into four general categories: Single String, Multiple Strings, Parallel Strings, and Clusters. Taking configuration into account NREL estimates for US wind farms that 70% of the permanent area is being used for roads. So there is a big reserve for the land use optimization while siting wind power turbines, electric grid and roads at the local level.
Wind farm should be sited in a place, where the land cover is as smooth as possible, because any roughness brings to decrease of wind speed. That is why strongest winds blow over the sea, what usually allows off-shore wind power plants produce more energy from each turbine. As land for wind farm is almost always can't be provided inside the inhabitable locality, most of appropriate places are related to agricultural land category. Wind farms also bring more energy when they are located far enough from wind breaking forests and mountains and use natural advantages of the landscape and wind microclimate.
When a wind farm is constructed it takes not much territory to use. But it's necessary to have roads to do technical maintenance several times a year. Wind turbines one with another are connected with power lines that can be put under the ground, but there is still a protection zone for each line. These two types of lines create a net of restrictions, which are seen to be barriers for use of the agricultural land around the towers. Though some part of the land is still free from these restrictions, the effective use of agricultural machines requires open ways forward and back to cover all the land. So taking agricultural farm land for wind farms is often necessary, but the matter of balance is to organize complementary use of land.

3.3 Social acceptance

Matter of social acceptance of wind farms sometimes falls out of planner's sight. People protesting aspect [16, 17] is often being seen as NIMBYism. However, when meeting the resistance of the local community in the construction of wind farms, one should look back

and consider whose interests are given the highest priority in the implemented policy. Is this the private sector or certain community groups?
Therefore, it is important to try, on the one hand, to engage the community to the development of renewable energy, overcoming the widespread misconceptions and spreading knowledge, and on the other hand, to critically evaluate concrete projects to find out the root causes of social contradictions.

3.4 Lack of properly adjusted law

Based on our analysis of Federal laws in the Russian Federation, two main features ignoring wind power specificity were found.
When there is still no design decision where each turbine should be built, wind farms need big plots of land, is almost always can't be provided inside the inhabitable locality, most of appropriate places are related to agricultural land category and forest land category, where any construction is forbidden (Land Use Code). General plan is the necessary step to change the category of land, usually to industrial land category. The procedure of change empowers regional administrations for agricultural land category and federal government for forest land category.
Construction of wind measuring towers according to the federal law (Urban Planning Code) because of their height is considered to be a kind of structure that needs a permit to build. Also Rules of land use and building (so called “PZZ”, zoning) should envisage that this permit will be asked to allow it. And general plan needs to be a basis for zoning (PZZ) to work together or PZZ can be cancelled by court. That is why general plan should reflect future wind measuring towers or the building permit can't be legally provided.
In this sense technical algorithm to be realized in legislative aspect needs to implement into general plan not just the wind power plant, but also wind measuring towers. As it's impossible to design the wind farm without data about wind resources, general plan needs to be changed two times: first to get a proper category of land and a building permit for wind measuring tower, and second to get the same for the wind power plant itself.
Based on the particular qualities of wind power projects, these two points (land use category and urban planning decision making) need to be changed at the national level. These legal issues can increase the project duration by one year at least, even if there is no controversy in local community.
As it was shown in this chapter most of wind energy challenges can be responded by planning system as a part of national legislation and by certain planning technics at the local level.

4. Method

The method used for further analysis is to assess the decision making process in parallel with formal planning documents' preparation using data on the first functioning wind farm in Russia, located in Ulyanovsk. We use contradictions identified earlier in this paper as a framework for this study.

5. Case study: Ulyanovsk Wind Farm

In Krasny Yar village in Ulyanovsk region in January 2018 the first wind farm in Russia was put into operation [18]. The 35 MW power plant was built by Finnish company Fortum and has 14 Dong Fang wind turbines [19].
Now we apply the assessment framework considered above to analyze this case against all the contradictions.

5.1 Environmental impact

According to official statements of the Fortum company, the necessary work towards reducing the negative impact on the environment was done.
First, the closest wind turbine to houses is located 900 meters far from them. Besides, new models with no mechanical transmission are installed, what makes the vibration and noise indistinguishable at a distance of 300 meters.
Second, the project of the wind farm construction contains sections on the environment protection and passed the state expertise and received a positive conclusion.
Third, since the wind farm is located next to Volga river, where bird migration routes pass by, dangerous events for birds can take place. For this reason, each wind turbine is equipped with ultrasonic bird repeller to keep them at a distance.
As wind farm has less then a year of operation, it's difficult to make a certain conclusion about its environmental impact, but certain necessary measures have been definitely undertaken.

5.2 Territorial requirements

First part of the Ulyanovsk wind farm, which is in operation now, was planned by the General plan of Krasny Yar municipality (located next to Ulyanovsk) (see Fig. 2). According to the State register of the real estate, current land area is 59,4 hectares.

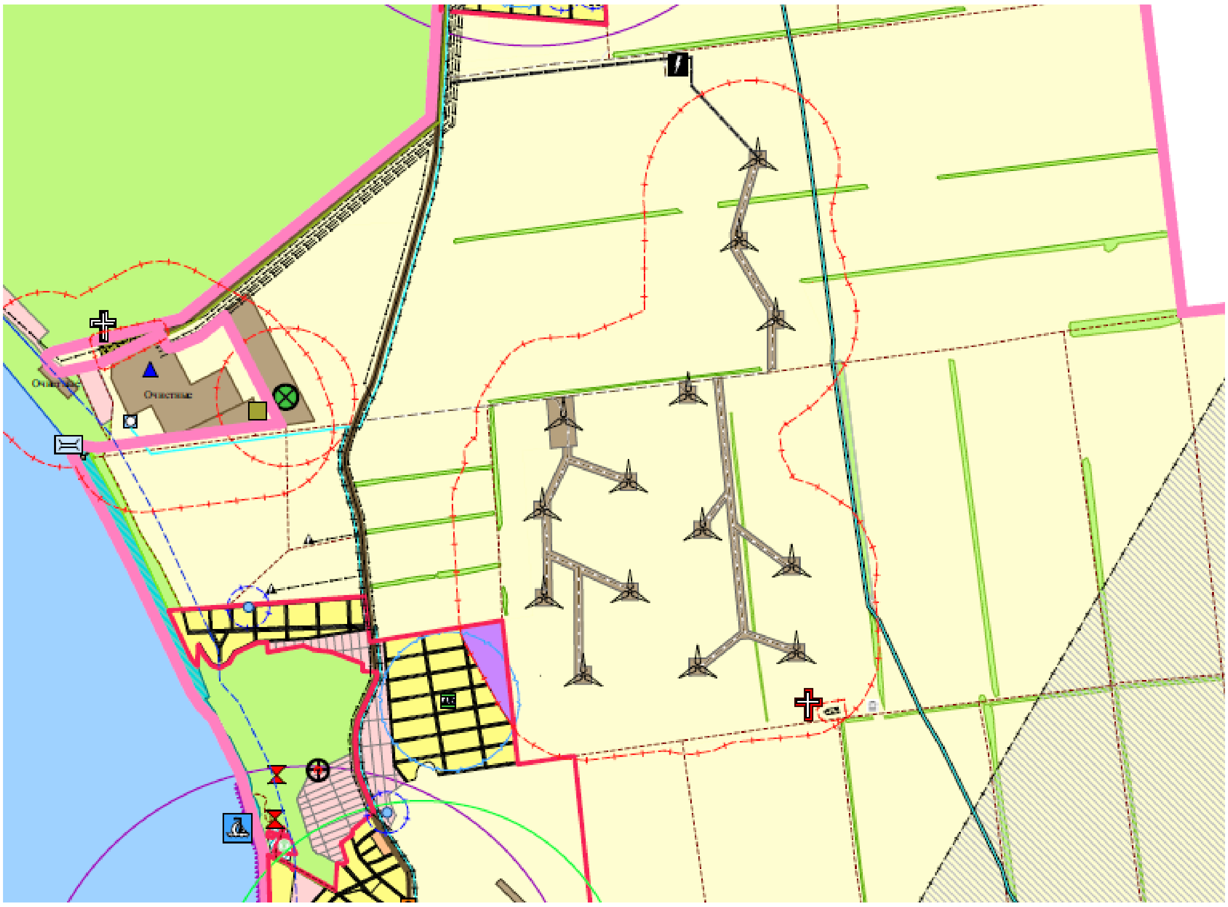


Figure 5 : Fragment of the general plan showing wind turbines and power lines (source: Federal state information system of territorial planning, https://fgistp.economy.gov.ru/)

Second part of the wind farm is announced to be built with installed capacity 50MW. Future development of the wind farm hasn't been reflected in the General plan yet, but a couple of land parcels, intended for this purpose, can be found in the same source – of 16,5 hectares in the northwest, and of 21,5 hectares in the north (see Fig. 3). Wind turbines can be recognized as small squares, connected with each other with roads and power lines.

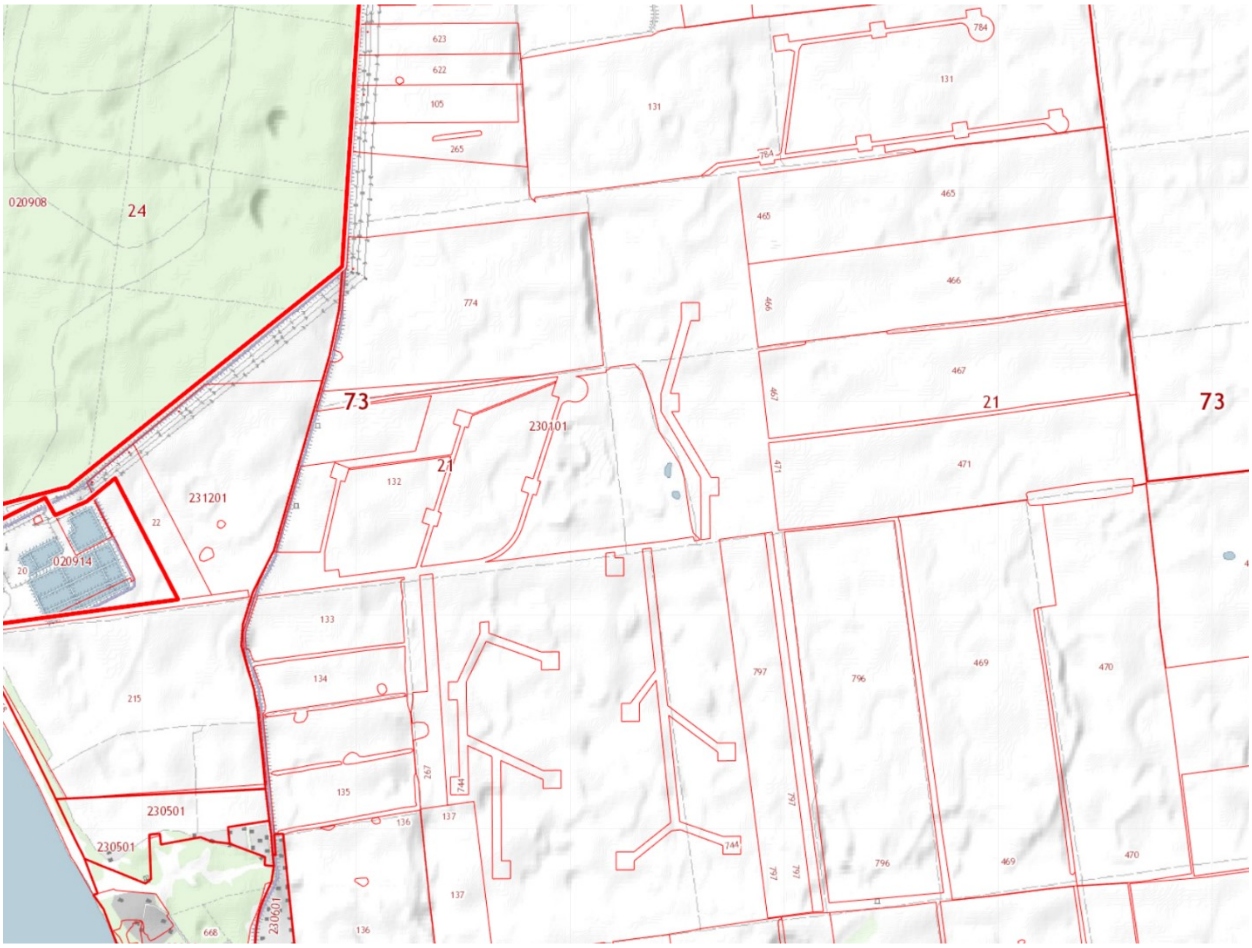


Figure 6 – Fragment of the public cadastral map (source: http://pkk5.rosreestr.ru)

As shown in the figures 2 and 3, the wind turbines are placed along the cluster scheme, which uses compact land plots. However, the use of surrounding agricultural land, especially soil tillage by machines, becomes impossible due to the presence of wind towers and their security zones. It means the actual area taken by wind farm is around 860 hectares in the central part and around 480 hectares in the north part. As each wind turbine has installed capacity of 2.5 MW, and 26 locations for wind turbines that can be distinguished now, the area for production of 1 MW equals 20,6 hectares. In comparison with NREL study and US average area of 34 ha/MW, Ulyanovsk wind farm uses land effectively.

5.3 Social acceptance

Analysis of the materials of Ulyanovsk media did not provide an opportunity to assert about the existence of a social conflict over the construction of the wind farm. However, there have been several publications of ornithologists concerned about the possible death of birds and journalists on corruption and violations during construction.
However, it seems that private sector and regional administration interests were drivers for this investment project while community interests are not formulated.

5.4 Lack of properly adjusted law

It was a long journey from the national tender for wind power company won in June 2015 (and the early preparations made to participate) to the end of the construction phase it took 2,5 years.
To force the realization of the Ulyanovsk wind project several administrative steps were taken.
1) Wind farm is being developed as a part of the long term strategy to create a technological valley to create conditions for increasing the investment attractiveness of the region. So wind power production becomes an answer for the needs of new consumers and especially for residents of Zavolzhye industrial park of 706 ha. Industrial zones development program in Ulyanovsk region started in 2007. It received financial support from the national government from 2008. In the industrial park over 30 investment projects are realized, and the number of residents is growing.
2) From the strategic perspective Ulyanovsk region and the regional capital have mentions of the technological valley, industrial park, wind power and other connected objects in their socio-economic strategies. But strategies are more declarative and reflect decisions that already were made. The effect of this on the development is limited.
3) To coordinate the future development of industrial park its territory was included to the Ulyanovsk municipality. It was done to have more taxes for Ulyanovsk and to have a single center for coordination. The regional decision on changing borders of municipalities was approved at the end of 2014. As the Ulyanovsk wind farm is located outside the new borders after the extension, wind power producing company pays prescribed taxes to Krasnoyarskoe rural settlement. And the future technological valley will develop in several neighbor municipalities.
4) To have the necessary information on wind resources of the site, proper measurement were made. It is an internationally accepted practice to build high structures with the equipment on top to collect data for a year. There is no detailed information about building permits for the construction of wind measuring towers. But the land parcel for the first part of the Ulyanovsk wind farm was formed for the exact configuration of the wind turbines before the General plan of Krasny Yar was changed to show where the wind farm is to be built. It means that wind measurements and wind farm design were ready earlier.
5) General plans of municipalities reflect comprehensive plans for energy and industrial development now. General plan of Krasny Yar was changed to adjust to the new requirements when decisions on the place and the configuration of the wind farm were already known. Technical parameters, which were accepted in general plans, earlier were detailed in territorial design projects. New version of Ulyanovsk general plan was presented in 2017. That is why the general plan for Krasny Yar shows the exact parcel for each wind tower.
6) German company (Assmann Beraten + Planen) developed a territorial design project for the Zavolzhye industrial park in 2011, and the territorial design project for the Ulyanovsk wind farm was developed by local specialists according to the data of Fortum.
7) Land readjustment for the wind farm territory was done to change the configuration of parcels and the allowed land uses according to general plan and zoning. Then with proper building permits and construction project developed, wind turbines were raised and power lines constructed.

6. Discussion of results

New wind farm in Ulyanovsk became a breakthrough and opened most of systematic and administrative inconveniences connected to national planning system and technological features of wind farms themselves.
Siting of wind farms on the national and regional level should be determined based on an analysis of energy needs and available wind resources. We assume that these sites can be detailed more. But the exact parameters for the power station shouldn't be designed at this stage.

The wind industry functions as a market, despite state regulation and the participation of state-owned companies. In such circumstances, decisions on the location of wind parks, including their comprehensive justification, are taken within the framework of the strategies and business plans of the companies. Public territorial planning, linked to such procedures as the transfer of land from one category to another, the provision of land plots from state and municipal property for construction, participation in federal and regional programs of investment development, becomes the mapping of the planned, not always required by the business entity.

The uncertainty about necessity of building permits for wind measurement towers we propose to clear by establishing a special order of getting permits for this type of structures. This order shouldn't include changing planning documents of strategic level such as general plans.

Land ownership played a visible role on siting the Ulyanovsk wind farm. Based on the configuration, it is likely that the land parcels for the wind farm were provided from the state and municipal property. As it's easier to provide land this way, it can be seen as a plus. But it restricts from making a wind farm from perspective of optimal siting to get more power in given natural conditions. To overcome ownership constraints, legislation needs to be completed by mechanisms of public private partnership in land ownership aspect.

Landscape has been out of sight during all the Ulyanovsk wind farm siting and design. We propose to take surrounding agricultural land into consideration when making a structure of power lines and siting each turbine. Changing the optimal siting scheme of turbines' allocation can help important qualities of agricultural land use to be kept.

7. Conclusions

The main findings of this paper include common international features and specific Russian planning issues, that should be taken in account.

Planning issues of the international importance include:

- wind farm siting as a specific aspect of providing building permits, designing power network, land use management, taken in account in planning system;
- transmission technology of strategic decisions for network development to land use planning while siting wind farms; interaction of public and private plans;
- standards and rules for environmental studies in wind farm projects;
- support mechanism of bottom up initiatives for community driven wind farm projects;
- partnership framework for land owners and farmers to optimize land use patterns and to make wind farms work within the existing agricultural landscape.

Russian planning issues of wind farm siting represent a simplified version of common world issues. To eliminate existing barriers and stimulate the renewable power production in Russia, the planning process for wind farm siting needs to be improved. It is more likely that these changes lie in the legislative field. Experience of planning and construction of the Ulyanovsk wind farm can already become a basis for simplification of existing procedures and strengthening of the planning expertise in Russia.

References

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