Wind Energy Resources of the Kola Peninsula (Russia)

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The Kola Peninsula (Fig. 1) is washed by the ice-free Barents Sea, in the north, and by the White Sea, in the south. The coastal areas are evaluated as one of the highest wind energy potential in the Russia’s European north. It is considerably higher than that in the coastal areas of the Northern Sea in Denmark, Germany, and the Netherlands, where wind-power engineering has got impetuous development over the last decades.

The Kola Science Centre of the Russian Academy of Sciences carried out a number of investigations to evaluate the technical resources of wind, (i.e. the energy produced by wind-energy converters - WEC). The investigation results have shown that if WECs are staggered at a step of ten wheel diameter from each other, the technical resources of wind, at the 20-kilometer northern coast of the Kola Peninsula, where winds are most intense, account for about 120 billion kWh, with the total installed capacity of WECs making up about 40,000 MW. This considerably exceeds the energy amount (18 billion kWh) generated by the Kola Energy System, and its generating capacity (3,700 MW). The use of the most accessible and commercially promising part of these resources is obviously of major interest.

The researches have shown that large wind parks of several hundreds megawatts in generating capacity may be embedded into the Kola Energy System. The compensating capabilities of the Kola Energy System (Fig. 2) comprising 17 hydroelectric power plants, with the total installed capacity of about 1,600 MW, allow power generating to continue if wind speeds fall below the design-based speed. It is expedient to build wind parks near hydroelectric power plants operating in the coastal area of the Barents Sea, because these are located in the zones of a higher wind potential, are connected with the central areas of the Murmansk region by well-arranged roads, have an initial infrastructure, and are connected to the Kola Energy System. It is possible to transfer wind power through the existing transmission lines under a voltage of 150 kV and 330 kV. In order to prevent transmission overload, power can be generated in a compensative regime - when high wind periods are long, the hydropower plant capacity will decrease. As a result, it will allow water reserves to accumulate during windy periods and these water reserves to be used when winds slacken. The “wind parks plus hydropower plants” system thus acquires more stable operational characteristics, transmission lines are not overloaded, receiving a steadier load, which improves their economic efficiency.
Fig. 2 shows effective hydropower plants included into the Kola Energy System and possible areas for wind parks arrangement. The most promising is the area of the Serebryanskiye hydropower plants (Fig. 2, Point 1). The total generating capacity of these hydroelectric power plants accounts for about 500 MW. For wind parks to achieve approximately the same level of capacity in this region is also possible. At present first steps in this field are being done. The company Windlife Arctic Power, the Netherlands, has coordinated with the Administration of the Murmansk region a site where a wind park is to be constructed. The site is located near the Murmansk – Serebryansкая HPPs highway. In the northwest part of the Kola Peninsula, a 100 MW wind park is going to be constructed by the company Russky Veter, St.-Petersburg (Fig. 2, Point 3). This wind park is applicable to the five 190 MW hydropower plants cascade, the Paz river.

The use of wind energy for heat supply is quite promising in the North. The peak in seasonal heat energy consumption coincides with the wind energy output peak. A joint operation of wind parks and boiler houses will turn wind from a negative climatic factor contributing to heat losses to a valuable heat energy source contributing to fuel economizing. The use of wind power for heating purposes does not necessitate high quality requirements for the energy produced by WECs. Of less significance is the basic drawback of wind energy – the instability of wind exposure because the fluctuations of WEC’s capacity are evened out by the accumulating ability of the heating supply system and by the heat reserved in buildings that received the heating. Another field of possible use of wind energy is the Shtokman gas-condensate deposit which is to be developed on the shelf of the Barents Sea. A liquefied natural gas plant to be constructed near Hydroelectric Power Plant XYVII will demand for its operation a huge amount of electric power (over 1500 MW, by the experts’ estimates), and, hence, it will concentrate huge loads. To supply the load, it will be necessary to construct local thermal power stations, most likely, gas-turbine power stations operating on natural gas. Under these conditions, the use of WECs, as well as their joint operation with gas-turbine power stations, will allow to reduce gas consumption for the plant’s natural needs by 30-40 %, which in turn will allow export gas deliveries to be increased.
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