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The role of conventional and alternative energy in the regions of the North

The article considers the specifics of energy supply in the Northern regions of Russia, the advantages and disadvantages of conventional and alternative energy. It is shown that large power plants will focus on conventional sources of energy for a long time. Alternative energy can play an important role in supplying power to small decentralized consumers. The development of alternative energy is also necessary to test new power generation technologies.

Power generation, alternative energy, the North.

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The territory of Russia's North is characterized by a heterogeneity of socio-economic development, economic conditions, unequal remoteness of different regions from transport and industrial centres located in temperate latitudes. The structure of the Northern regions' economy differs depending on the prevailing mineral, forest or other natural resources on their territories. But in any case, the provision of population's livelihood and normal functioning of the socio-economic system in harsh climatic conditions require reliable supplies of power to consumers. Organization of power supply in the regions of the North has its own specifics, conditioned by the presence of certain energy resources, history of economic development of different regions, their remoteness from existing oil and gas pipelines, concentration of large consumers in industrial hubs, population density, grid infrastructure development level and other factors.

The system of centralized power supply covers a significant part of consumers in the North. In some regions (Republic of Karelia, Murmansk Oblast) energy supply is carried out centrally by almost 100%. Thermal power stations (TPS), steam electric stations (SES), or state district power stations (SDPS) are major energy producers in most of the Northern regions with a predominantly centralized energy supply. Hydropower plays a significant role in the Republic of Karelia and Murmansk Oblast, hydroelectric power stations (HPS) operate in the Republic of Sakha (Yakutia), Magadan Oblast. Nuclear power stations operate in the Murmansk Oblast (Kola NPS) and in Chukotka Autonomous Okrug (Bilibino NPS). Centralized power supply covers areas with a relatively high population density, like industrial hubs with major producers and major consumers of energy (industrial enterprises, large settlements).

Transfer of power from producers to consumers in this case is carried out by transmission lines of different voltage.

At the same time, low population density and the presence of many small energy consumers are among the characteristic features of the vast Northern territories outside industrial development zones. These consumers are located mainly in remote areas inhabited by rural and indigenous population. Their centralized power supply is inexpedient, because it would require the construction of extensive and expensive infrastructure for energy transfer, and significant losses would occur in the process of transmission. Therefore, the energy supply of small remote consumers is decentralized. Such consumers are not connected to the regional energy system (let alone the Unified Power System of Russia), they are supplied with power from independent sources, represented mainly by small state or departmental power stations. Based on the volumes of produced and consumed energy, one cannot say that decentralized power supply plays a leading role in the Northern regions. Only a small percentage of power in the total amount is generated by decentralized plants. But it is necessary to support the decentralized energy generation on the vast Northern territories, otherwise the living conditions of the population will deteriorate, the development of existing natural resources will slow down, and strategically important territories will become depopulated. Decentralized power production is effected at small-scale power generation facilities, the majority of which are diesel-fired. There is no uniform interpretation of the term "small-scale power generation", its facilities have one common feature – low power. In [9] small-scale power generation is defined as "power suppliers with the units (boilers, turbines) that have a unit capacity of up to 25 MW, designed for supplying power to industrial and municipal consumers and operating along with the regional power system or autonomously".

Many small power stations should be provided with fuel. At that, a lot of Northern territories face the problem of limited transport accessibility, since fuel and energy resources, as well as foodstuffs and other necessary goods can be delivered only in short periods of marine and river navigation in the framework of "northern delivery". The high cost of generated electricity and heat is conditioned by the following factors: the necessity to deliver energy resources from afar and create their significant seasonal reserves; the long duration of the heating season.

An urgent issue concerns the supply of fuel to the regions, where the degree of development of local fuel and raw material reserves is low – the Murmansk, Magadan, Arkhangelsk oblasts, and Chukotka Autonomous Okrug [17]. But even the Northern regions with developed large-scale mining and production of energy resources need oil and coal deliveries in significant amounts. Even such regions as Khanty-Mansi and Yamalo-Nenets autonomous okrugs, Republics of Komi and Sakha (Yakutia), Kamchatka Krai and the Sakhalin Oblast are to a greater or lesser extent dependent on the deliveries of certain kinds of fuel and energy resources from other regions.

Thus, despite its substantial fuel and raw material base, the Sakhalin Oblast depends almost completely on the import of petroleum products from the continent: the oil produced in the Sakhalin Oblast is exported or it is directed for processing to Khabarovsk Krai; it is then re-imported to the oblast in the form of finished oil products [17, p. 93]. A similar situation is observed in other oil-and-gas-producing regions. Thus, the issue of fuel supply and, accordingly, the high cost of electric and thermal energy, produced on its basis, is relevant not only for decentralized energy supply of small remote consumers, but also for territorial power systems, having large thermal power stations in their composition.

It is necessary to solve the existing problems and obtain the following results: the reliability of power supply to consumers should be improved, the growth of energy prices curbed, the level of energy security in the Northern territories enhanced, and the deterioration of ecological situation prevented. A promising direction of power industry development in the Northern regions, reducing the acuteness of these problems, consists in the expansion of the implementation of non-conventional, renewable energy sources (RES). The involvement of local RES in the economy is often considered a way to solve the problem of supplying power to small decentralized consumers. At the same time, some authors propose the wide use of RES in the power system, so that in the future they could replace traditional energy sources; in particular a complete abandonment of nuclear energy is suggested. This article is devoted to the analysis of the role that different sources of energy play in the regions of the North.

Let us specify some concepts.

Conventional energy includes production of energy using traditional sources: heat of burnt fuel (heat power), waterpower of rivers (hydropower), and energy of controlled nuclear chain reaction (nuclear energy). In many cases, power plants working on traditional energy sources and included in the power systems have high capacity, i.e. the power generated by such plants is transferred to consumers through power transmission lines. On the other hand, in the areas of decentralized energy supply, many small-scale power generation facilities work on traditional fuel sources.

Non-conventional energy includes production of energy from non-conventional sources. Non-conventional energy sources are such sources the use of which for generation of power and thermal energy has not yet acquired large-scale character for a number of reasons. The main non-conventional sources of energy are wind energy, water power of small rivers, energy of the sun. Treating water power of small rivers as a non-conventional energy source is questionable, because a lot of small HPS were built in the 1960s, but later many of them were abandoned [10]. Non-conventional energy is also called *alternative*, because it represents an alternative to conventional energy.

In addition to conventional and non-conventional sources, one distinguishes between renewable and non-renewable energy sources. Non-renewable energy sources are fossil fuels (including coal, oil, gas), nuclear fuel. Renewable energy sources are almost always non-traditional, therefore, one commonly uses the term "non-conventional renewable energy sources" that are the "sources that are always present or recurring in the environment in the form of flows of energy from the sun, wind, geothermal energy, energy of seas, oceans, rivers, and biomass" [8]. The list of renewable energy sources, as defined by the Federal Law "On electric power industry" dated March 26, 2003 No. 35-FL, includes solar energy, wind energy, energy of water, tidal energy, wave energy of water objects, geothermal energy with the use of natural underground heat carriers, biomass, biogas, etc.

Conventional energy is based mostly on the use of non-renewable energy sources (except hydroenergetics). Alternative (non-conventional) energy is focused on the use of non-conventional energy sources. Alternative or renewable energy should not be identified with small-scale power generation.

Both conventional and alternative energy types have their advantages and disadvantages. Their overview, based on analysis of works [1, 2, 4, 5, 10, 13, 15] is given below.

The main advantages of conventional energy are:

- high density of energy flows (hundreds of kilowatts, and sometimes megawatts per square meter);
- high degree of technologies development and the developed structure of equipment

production at all stages: exploration of energy resources, their extraction, transportation, processing, usage, energy production and its transfer to consumers;

- developed infrastructure of research institutions, and scientific and operational personnel training structure.

The main shortcomings of conventional energy are:

- depletion of fuel and energy resources; easily accessible hydrocarbon reserves have been already exhausted, new fields have to be developed in remote areas (Polar regions, Eastern Siberia, shelf) that increases the cost of production;
- dependence on the amounts of supply, on fuel prices, on the situation in the market of fuel and energy resources;
- negative impact on the environment: pollution by wastes, thermal pollution, emission of carbon dioxide into the atmosphere by thermal power stations, which creates greenhouse effect; coal-fired power stations are especially harmful, because they produce large amounts of ash, soot, sulfur oxides and nitrogen oxides, which cause acid rains;
- great demand for water;
- potential threat of man-made disasters, including accidents at NPS with emissions of radioactive substances.

Alternative energy is focused mainly on the use of RES that are not only opposed to traditional energy resources, but that are also significantly different from each other by the nature of their generation and use. Accordingly, alternative energy has both the general advantages and disadvantages, and those inherent in a definite type of RES.

The main advantages of alternative energy:

- utilization of renewable and virtually inexhaustible sources of energy (wind, solar, geothermal, and tidal energy, etc.) allows using hydrocarbons in other sectors of the economy (in oil and gas chemistry);
- focus on the usage of local energy sources (sun, wind, geothermal energy, biomass) provides the approximation of generation facilities to the objects of consumption, allowing a 15–20% reduction in energy losses associated with its transmission and distribution;
- less negative impact on the environment compared to conventional power: the absence of emissions of pollutants when using RES, absence of heat pollution; the absence of environmental costs connected with mining, processing and transportation of fossil fuels;
- in most cases, power stations operating on the basis of RES, are easily automated and can operate without direct human participation;
- low probability of man-made disasters;
- opportunity to use the land on which non-conventional power plants (wind power plants, heat pumps, damless HPS), for economic purposes;
- insignificant water demand (for solar, wind power stations);
- development of alternative energy stimulates the development of science-intensive technologies;
- wind power requires only slight withdrawal of land: the area between wind turbines can be used in agriculture; if a wind turbine is installed in marine waters, there is no necessity of land withdrawal at all;
- tidal energy does not cause flooding of lands;
- solar panels can be mounted in almost any suitable place (for example, on the roofs of houses or on unused land). If necessary, solar power stations can be easily and quickly dismantled and the land used for other purposes.

The main disadvantages of alternative energy:

- in most cases, alternative energy is of a diffuse character and is characterized by low density of energy flows (solar radiation is less than 1 kW per square meter, wind at the speed of 10 m/s and water stream at a speed of 1 m/s – about 500 W per square meter), which leads to the necessity of constructing large power installations;

- alternative power plants often lose out to conventional ones by economic indicators, consequently, they have significant payback period and low attractiveness for private investments;
- instability of power delivery and, consequently, the impossibility of forecasting the production of electricity and changes in the power of the station by the operator of the energy system;
- the necessity of backing up alternative energy with conventional energy facilities (for unstable sources of energy, such as solar and wind power); experience shows that when the share of capacity of power installations working on unstable sources of energy begins to exceed 20%, the power system may face serious problems, the prevention of which requires the introduction of additional regulatory capacities;
- construction of expensive complicated infrastructure to ensure the possibilities of obtaining electricity from other manufacturers (or other areas) in the case of decrease in the production of electricity from unstable sources, the necessity to create "smart grids";
- underdeveloped industry for the production of power installations, operating on alternative energy sources in Russia;
- placement of wind farms requires a lot of space (in some cases this drawback is compensated by the possibility of using the territory between the wind turbines for agricultural purposes);
- the work of large wind turbines (with a capacity of over 1 MW) may interfere with the transmission of television signals; large wind turbines placed in the coastal zone can create difficulties for military radar stations, which makes it necessary to carefully choose the location for such facilities on the strategic coastal areas of the North;
- tidal power plant (TPP) provide energy into the grid in four peaks a day; when constructing large TPP this may require construction of additional regulatory capacities;
- strong dependence of electricity generation by small HPS on river behaviour;
- high cost and, respectively, low economic efficiency of solar energy.

It is obvious that when searching for an answer to the question what energy is better, one can not focus on the number of positions in the above lists of advantages and disadvantages. For making decisions on the development of certain type of energy it is necessary to consider many factors including not only the availability of resources, but also the demand for energy, existing technologies, electricity generation costs, the range of its transmission to consumers, etc.

The alternative energy has both supporters and opponents. According to Konstantin Simonov, Director General of the National Energy Security Fund, "one of the main arguments of supporters of renewable energy is that... the whole Europe, the whole world is engaged in renewable energy, and we lag behind substantially, so we need to compensate for this lag urgently, urgently" [18]. Simonov indicates that "in Europe the situation is very different from the point of view of power generation. Europe has scarce hydrocarbon reserves. Europe buys oil, gas, coal abroad, i.e. in general, it faces the necessity of importing primary energy resources and it tries to find ways to produce electricity on its territory. The experience of the Europeans is quite poor at that. In terms of pricing, by the way, as well ... we have a completely different situation in the energy sector. Our country is the world's largest producer of oil and gas" [18]. In light of this, the desire to develop alternative energy is nothing more than a popular tendency.

Table 1. Capital investments in power stations of different types

Type of power station	Capital investments, US dollars/kW	
	2005	2030 (forecast)
Conventional hydroenergy	1550–5500	1550–5500
Nuclear power stations	1500–1800	1500–2300*
Coal-fired TPS	1000–1200	1000–1250
Gas-fired TPS	450–600	400–500
Ground-based WPS	900–1100	800–900
Offshore WPS	1500–2500	1500–1900

*Authors' estimation [1].
Source: [1] with reference to the International Energy Agency.

As already noted, the power stations working on non-conventional energy sources often lag behind traditional power plants in terms of economic indicators. *Table 1* shows the evaluation of the specific capital investments in power plants of various types. Currently, gas-fueled generation is the cheapest. From the types of power plants presented in the table, in the foreseeable future the reduction in the unit value is forecasted only for wind power stations (WPS) and TPS working on gas. But it concerns not only the unit cost of 1 kW of installed capacity. The capacity factor (CF) of solar and wind generation is several times lower than that of conventional energy [14]. Over the past decade, indeed, there has been a significant improvement in economic indicators of power plants working on the basis of non-conventional energy sources, and in some cases they can compete with conventional power plants. But often lower values of CF, combined with the dispersed nature of most non-conventional energy sources increase the cost of energy production and reduce the attractiveness of alternative energy for investors.

Opponents of alternative energy indicate the instability of alternative sources and, as a consequence, the necessity to back up non-conventional power plants with traditional energy facilities. However, as the practice of some countries shows, if non-conventional power plants account for no more than 20% of the installed capacity and there is an advanced network infrastructure connecting consumers with power plants of different types, there is no need in complete duplication of capacities. At the same time, if we speak about small remote consumers, whose energy supply comes from non-conventional power plants, isolated from the energy system, it is necessary to back up a greater part of the capacity (or the whole capacity). In other words, if the remote isolated consumer uses, for example, wind energy installation, it should have a diesel generator and a reserve of fuel for its operation in case of no wind.

Table 2 provides data on energy supply of Russia's regions that are completely attributed to the territory of the North. The table was compiled using the materials [3, 6, 7, 11, 12, 16, 19, 20].

Despite significant technological potential of some non-conventional energy sources, the plans to build large power plants on their basis, as a rule, remain on paper. On the contrary, the projects of constructing small energy objects on the basis of non-conventional energy sources are more frequently implemented practically. At that one can notice a pattern: if the region has more decentralized energy consumers, if it is less covered by the networks of power lines and transport networks, if it is more remote from the suppliers of fuel and energy resources (oil refineries, coal mining enterprises, systems of transportation and distribution natural gas), then such region pays more attention to the practical implementation of the projects for the development of alternative energy sources.

Table 2. Specifics of power supply of the Northern regions

Region	Power supply on the territory	Large conventional capacities	Potential and significant projects of alternative energy
Murmansk Oblast	Centralized, decentralized	NPS, HPS	Kislaya Guba tidal power station is operating, installed capacity is 400 kW. High wind potential. Experimental wind turbine with a capacity of 200 kW. There are unrealized projects for constructing wind farms. A project of construction of wind turbines with the capacity of 150–400 kW for a collateral operation with diesel engines for power supply of small consumers has been developed.
Republic of Karelia	Centralized, decentralized	HPS, SES	Six small hydropower stations are in operation. Peat reserves are available. In some localities it is intended to build five wind farms with a total capacity of 15.1 MW. Possibility of using wood waste and animal waste is considered.
Arkhangelsk Oblast	Mainly* decentralized	TPS	There are two wind-diesel units with the capacity of 450 KW and 100 KW. The feasibility study for constructing mini-TPS working on biofuel with the capacity of 5 MW was approved. There is a project of the Mezenskaya tidal power station, which capacity in 2020 could reach 700 MW, and in the future – 4000 MW.
Nenets Autonomous Okrug	Decentralized	Absent	Long-term target programme for the development of energy complex of the okrug provides for the creation of wind-diesel power plants in remote settlements.
Komi Republic	Centralized, decentralized	TPS	In 2006 a plant for production of biofuel (fuel granules) with a design capacity of 1.200 tons of biofuel per month was put into operation; markets: Western Europe, and consumers in the region. The wind power park Zapolyarny (2.5 MW) is operating.
Yamalo-Nenets Autonomous Okrug	Mainly decentralized	TPS	Data not available.
Khanty–Mansi Autonomous Okrug–Yugra	Mainly decentralized	TPS	Available RES: timber industry waste, bioenergy potential of agricultural waste; energy of small rivers. It is possible to build wind turbines in remote villages.
Tyva Republic	Decentralized	Absent	Compact solar power stations with the capacity of 140 W were developed in the framework of the programme “400 solar yurts”. The Concept for the development and the scheme for placing the small hydro power facilities on the territory of the Republic of Tyva” was elaborated, according to which a small HPS has been already commissioned.
Republic of Sakha (Yakutia)	Mainly decentralized	TPS, HPS	Since 2007, a wind power station with a capacity of 250 kW has been operating in the settlement of Tiksi. In 2011 a solar power station was launched, with the capacity of 10 kW in collaboration with a diesel power station; in 2012 its capacity was increased to 30 kW. In 2012 another solar power station with the capacity of 20 kW was commissioned. It is planned to construct a low power SES in areas with woodworking industry waste. Plans are being considered for the construction of HPS of small capacity.
Magadan Oblast	Mainly decentralized	TPS, HPS	Data not available.
Chukotka Autonomous Okrug	Decentralized	TPS, NPS	A wind-diesel power plant with the capacity of 3.0 MW was built in 2003. The construction of wind plants is planned along the entire Eastern coast. In 2001 a project for the development of Kukunsky hot springs and construction of a system for supplying hot water to the settlement of Lorino was developed, and the feasibility study of the utilization of geothermal resources for constructing the central heating system in the settlement of Novoye Chaplino was carried out.
Kamchatka Krai	Decentralized	TPS	There are two 250 KW wind turbines on Bering Island and a small HPS with the capacity of 1.7 MW. There are three geothermal power stations with a total capacity of over 70 MW. Geothermal resources are estimated at 5000 MW.
Sakhalin Oblast	Centralized, decentralized	TPS	There are geothermal sources there. The first unit of Mendeleev geothermal power plant with a capacity of 1.8 MW and a geothermal heating station GTS-700 capacity of 17 Gcal/h have been put into operation on Kunashir Island.
* Mainly by the area of the territory covered.			

The Murmansk Oblast is a region abundant in energy, and here the projects in the sphere of alternative energy are of experimental character. On the Barents Sea coast, 90 km from Murmansk there is the Kislaya Guba tidal power station, which was provided for studies to the Research Institute of Energy Structures (NIIES), and the Research Institute "Hydroproject". The Oblast had the experience of constructing an individual wind turbine (wind power installation JSC "Vetroenergo" with the capacity of 200 kW [1]).

Republic of Karelia, unlike the Murmansk Oblast, has scarce electric power, and pays more attention to alternative energy sources. Despite the fact that Karelia can receive (and receives) an excessive capacity of the Kola energy system via power lines, the republic is interested in enhancing its own energy independence and energy security of its consumers, including small consumers. Six small hydropower plants are already in operation there (technically, they are part of the Sunsky HPS cascade). The possibility of using wind resources of the Ladoga and Onega areas, peat reserves, the use of wood waste and animal waste to produce electricity and thermal energy.

A long-term target programme on the development of power complex of the Nenets Autonomous Okrug provides for the creation of innovation wind-diesel power plants in the region's remote settlements, which will significantly reduce public expenditures on "northern delivery". The Arkhangelsk Oblast has a wind-diesel complex in the settlements of Kamenka (450 KW) and Dolgoshchelye (100 KW), the feasibility study of the construction of a 5 MW mini-TPS working on biofuel in the settlement of Leshukonskoye has been approved. A major project is the construction of the Mezenskaya tidal power station, but it is not clear whether this project is going to be implemented, because it is valid only for a maximum variant of the general scheme of placement of electric power industry objects till 2020.

The Republic of Tyva is different from other regions, referred to the North, by the fact that it is not located in the high latitudes. This leads to relatively greater prospects for solar power in the region; it was reflected in the adoption of the republican programme "400 solar yurts" in 2003, which implies the construction of compact solar power stations. The Republic also plans to create small hydro power facilities. This kind of small power sources are suitable for using in remote, mountainous and difficult-to-access areas of the region.

Yamalo-Nenets and Khanty-Mansi autonomous okrugs, the republics of Komi and Sakha (Yakutia), Kamchatka Krai and the Sakhalin Oblast are in the better conditions according to the criterion of self-supply of energy in comparison with other regions of the North [17]. At that, Yamalo-Nenets and Khanty-Mansi autonomous okrugs, and the Republic of Komi are better equipped with the infrastructure for fuel deliveries (oil pipelines), and the power engineering in these regions focuses on conventional energy sources, although these regions possess alternative sources in significant amounts. Among the projects related to alternative energy sources it is necessary to point out a biofuel-producing plant constructed in the Komi Republic in 2006, however, it is oriented not only toward local consumers, but also toward export.

In 2007 the Republic of Sakha (Yakutia) launched a wind turbine that generates energy for the settlement of Tiksi. In 2011 for the first time in Yakutia a 10 kW solar power station running in parallel with a diesel electric power station was launched in the settlement of Batamay (Kobyaysky district). Solar panels have proved their efficiency; as a result, in 2012 the capacity of the plant was increased up to 30 kW, and another 20 kW solar power plant was built in the settlement of Yuchyugey (Oymyakonsky district) [11]. In the future it is planned to build small-capacity cogeneration plants running on local fuels or woodworking industry waste, and low-power HPS.

The reserves of renewable energy in Chukotka Autonomous Okrug are significant, but they have not been used much so far. In 2003 the first wind-diesel power plant with the installed capacity of 3.0 MW was build there. In the future, it is planned to build wind plants along the entire Eastern coast of Chukotka. Geothermal resources available in the autonomous okrug can be used to provide the operation of systems for hot water supply and central heating in the nearby communities.

The Kamchatka Krai has several kinds of alternative power stations. It has a small hydropower plant on the Bystraya River, two wind turbines on Bering Island, and also three geothermal power plants. All geothermal stations are owned by JSC Geoterm, which is a subsidiary of JSC RusHydro. Such a variety of alternative power stations in Kamchatka can be explained not only by the availability of relevant energy sources and decentralized energy supplies to consumers in the most part of the krai's territory, but also by the isolated location of Kamchatka Krai on the peninsula; this fact contributes to the orientation of energy on local resources.

Non-conventional energy in the Sakhalin Oblast on the Kuril Islands is represented by geothermal springs. On the island of Iturup there are the explored reserves of steam-water mixture in a quantity sufficient for providing the town of Kurilsk with electricity. The island of Kunashir has already put into operation the first unit of Mendeleev geothermal power plant and a geothermal heating station.

Thus, different regions of the North show successful examples of small energy facilities based on alternative energy sources. But large power plants are not constructed on their basis. This can be partly explained by the fact that the considerable part of the sparsely populated Northern territories in general has no need in large-scale power plants. However, the projects of large power plants based on alternative sources are not implemented in the regions with higher population density, with large industrial consumers, and in those regions, where non-conventional power stations could operate as a part of regional energy systems along with conventional facilities. So, the projects of wind farms on the coast of the Barents Sea in the Murmansk Oblast remained on paper. It is not clear whether the project of constructing the Mezenskaya tidal power station in the Arkhangelsk Oblast will be implemented.

The role of traditional and alternative energy in the energy supply of the Northern regions is determined by its advantages and disadvantages. A certain kind of energy is developing, where it is expedient. Conventional power industry will still play an important role in the areas with relatively high population density, in the regions with large industrial hubs, and in those regions, where the emphasis was made historically on the construction of large power plants (mainly heat and/or hydropower plants). Some non-conventional power-generating facilities in these regions can be created for small consumers, who are remote from industrial hubs and are not connected to the power transmission line. Some non-conventional power plants can also be used in the experimental order. But mass construction of large power plants on the basis of alternative energy sources that can replace conventional energy industry in the coming years, is not expected in these regions.

Alternative energy in the Northern regions plays its role, which is important, but different from that of conventional energy. Exploitation of alternative power facilities is suitable where there are a lot of decentralized consumers, where population density is low, i.e. in the areas that are in need of small power. In remote areas the operation of small scale alternative power installations focused on the use of local alternative energy will help reduce the acuteness of the issue concerning the "northern delivery" of fuel, it will also reduce the cost of electricity production, improve security of supplies of energy to local small consumers. This does not mean that remote areas can completely abandon the traditional capacities, since the capacities of alternative energy should, to some extent, be backed up by conventional energy facilities, so that in case of the decline (termination) of energy production it would be possible to switch from a non-conventional energy source to the energy supply from a reserve source. However, the role of alternative energy in the Northern regions is higher than in most of other regions, due to the specifics of productive forces placement, low population density, etc.

It should be noted that the development of alternative power is important from another point of view. Currently Russia exports oil and gas and, in general, it has no shortage of fuel and energy resources (although some individual regions are facing the problem of fuel deficit very seriously). But the traditional fuel and energy resources are exhaustible, their easily accessible supplies have been depleting, and the cost of production will only increase. A significant part of the hydropower resources of large rivers has already been developed. All of this indicates that sooner or later our country will require diversification of primary energy sources by more extensive development of alternative energy resources. However, Russia essentially lags behind the leading countries in development and implementation of technologies for using alternative energy sources. State support to the development of alternative energy, as a matter of priority provided to the projects based on the technologies developed in Russia and with the use of Russian equipment, will contribute to the reduction of this lag.

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