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Spatial aspects of electric power industry development in Russia's European North*

The article deals with the Karelian-Kola and Dvina-Pechora parts of the electric power system located in Russia's European North (REN) as the structures of trans-regional level. A comparative system analysis of these objects revealed their common and distinctive features, and the problems of their spatial organization. As a result, important factors of enhancing integration ties have been determined. Besides, the article highlights the main directions of spatial development of REN power supply system.

Russia's European North, economic space, electric power systems, spatial organization, modernization.

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The role of space in electric power industry modernization

Economic space research methodology is based on the creation of different abstract images – multivariate models, describing its properties and revealing its development regularities [1, 2, 3, 4]. The research is based mainly on a system approach, which consists in the presentation of economic space as a single complex of interconnected natural, social, technological systems, in the study of their interactions, formation principles, trends and development criteria, regulatory institutions. The results of scientific research on economic space, when applied in practice, should determine the optimal mechanisms of interaction and trends of development, and also contribute to the creation of an efficient system of management of these processes.

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What is meant here, is the paramount importance of progressive transformation of institutional environment, which is an active structure of economic space, defining the rules of its functioning and transformation conditions.

In this regard, "spatial development should be considered as an approach to state objectives of development management, based on the system-structural notions of the country's integrity and instruments of such management" [5, p. 18].

Electric power industry or power supply as a branch or type of activity is an integral component, a constituent part of economic environment at any level of its territorial hierarchy from a global to a local one. At the same time, power supply systems are developing in accordance with the properties and characteristics of economic space, such as the requirements of economy and population, geography and climate, ecology, resources, state of energy infrastructure and economic potential. "Development of a region's energy sector takes place under the influence of external factors, determined by upper level systems of the hierarchy and related natural and socio-economic systems" [6, p. 95]. There is a close interrelation between the state of economy and the developmental level of its energy supply system. Therefore, in the abstract image of economic space, the characteristics of an electric power system represent a direct or indirect display of all the spheres of this space in energy indicators (coordinates).

It should be emphasized, that characteristics of spatial fragmentation and cohesion become crucially important in the creation of energy supply systems of any level, considering their technological features: remoteness of power facilities (both from each other and from consumers) and mandatory nature of power supply connections (network topology), priority of technical conditions of system interaction, continuity of energy production, distribution and consumption (physical and technical regularities), external connections with fuel supply systems (cross-sectoral integration). Technological condition of power supply systems determines the possibility of their institutional organization development, since the presence or absence of technical alternatives of power supply of the consumers creates conditions for a competitive or monopolized market, in accordance with which the rational options of business processes are selected.

A functional connection, which shows the role of economic space in the development of electric power industry, is created in the following sequence: characteristics and properties of the space → its development capacity, forecasted transformations → rational formation of energy systems (technology, organization, potential). The necessary detailed elaboration of this sequence leads to increasing complexity of integrated research in energy and economics and greatly complicates its informational and methodological support. Modern tools of system research in energy sphere help to overcome the emerging difficulties [7, 8]. The tools include a set of models in the spheres of energy and economics according to the sectoral and territorial structure, designed for forecasting production and investment activities, material and financial flows, for the analysis of organizational structures and multi-objective optimization of development according to energy, economic, environmental and social performance criteria. The planning of electric power systems means the selection of rational options for the development of production, and its achieving implies the creation of favourable conditions and sources of practical implementation. At that, the urge towards a rational way of electric power industry development envisages sustainable and adaptive solutions taking into account "the influence of economic factors (such as demand, fuel prices and the cost of construction of new facilities) and non-economic factors (environmental, socio-political, regulatory, institutional and other constraints)" [8, p. 83].

The strategic task of electric power infrastructure development in Russia, according to [9], consists in a comprehensive and accelerated modernization, i.e. a large-scale renewal of production technologies, and significant enhancement of the quality of the whole system of energy supply and energy saving. Some progress in technological modernization has already been achieved in the construction of new facilities and reconstruction of existing ones with the introduction of new, advanced machinery and equipment for power generation, transformation and transfer. It may be assumed that rapid development of advanced technologies will lead to progressive structural changes both in electric power industry and in economy as a whole. Institutional modernization has been going on continuously. It is aimed at improving the conditions and forms of organization of economic activity, the rules of interaction between the subjects of power supply, which requires additional efforts aimed at the structural and functional reorganization of energy systems and creation of appropriate legal and regulatory framework for their development. The strategy for the country's electric power industry modernization actualizes the objectives of the research of spatial structures and relationships of energy and economy in the part of forecasting their transformations on the basis of scientific-technological progress and institutional innovations. Modernization should result in "the enhancement of reliability of power supply and energy security of the country, the growth of energy and ecological efficiency of electric power industry facilities, providing, in general, the decrease in growth rates and stabilization of tariffs for electric and heat energy" [10, p. 9]. According to such targets, the indicators of efficiency and reliability of electric power supply should be considered as the criteria for planning and monitoring the development of electric power industry, and not only for the national system as a whole (general macroeconomic indicators), but also for its regional subsystems (field of values) in order to reflect the heterogeneity of its spatial structure and identify problem areas.

In the context of the research on the spatial development of Russia's North, [3, 11] the studies of energy supply systems formation and modernization should, in our opinion, be specified by the analysis and evaluation of the following:

- ✓ reasons for and factors of regional differentiation of the conditions of energy supply and energy efficiency of production;
- ✓ configuration and regional decomposition of economic and technological properties of power systems;
- ✓ efficiency of business structure of the wholesale and regional energy and power markets;
- ✓ factors and methods of inter-regional energy supply integration;
- ✓ main relations with other components of economic environment (resource provision and settlement system, energy requirements for economic development, environmental conditions, etc.);
- ✓ capacity and directions of technological and institutional modernization;
- ✓ requirements for the development of electric power industry, potential sources and mechanisms of their provision.

It seems that consideration of these positions with regard to the territorial factor, will provide a detailed characteristic of significant factors of economic space in the process of energy economy modernization in the North.

Spatial organization of electric power industry in Russia's European North (REN EPS)

Analyzing the spatial organization of electric power industry requires clarification of the following points: the peculiarities of objects' allocation, configuration of network connections and mechanisms of cooperation;

besides, the choice of the object of research is crucially important here. This determines its integrity, i.e. the systemic character of the object's functioning, the level of affordable aggregation and necessary specification of its structure; in addition, this determines the hierarchy of competences in the object's management. For example, the study of the spatial organization of regional energy systems requires specifying their structure at the level of energy units – centres of generation and consumption, their interactions and significant external relations, which will be the objects of management contributing to the optimal development of the entire system. The object of the present study is the electric power industry of the European North of Russia[1], thus the regional energy systems, their relations and cooperation are considered as the structural elements of the first level, and the issues of their coordinated development are highlighted. It should be emphasized that the formation of the hierarchy of power supply systems in the Northern regions led to the predominance of the regional principle of delimitation of competences and technological integrity. The 2005 – 2008 organizational reform of power industry, resulting in the establishment of generating companies of the extraterritorial level, created new centres of responsibility and redistributed cash flows, but it didn't changed the essentials of functional linkages and interactions of the subjects of power supply.

Power supply of the consumers on the territory of REN is provided by 4 regional energy systems – Kola, Karelia, Arkhangelsk and Komi, included in the unified electric power system of the North-Western Federal District (UEPS of the North-West). The location of the main power stations and system-forming power transmission lines (PTL) is shown in *fig. 1*. It is clear that the spatial configuration of the power system of REN is presented by two parts – the Western (Karelian-Kola) and the Eastern (Dvina-Pechora), which are not connected directly with each other.

The Western part is the association of regional energy systems of the Murmansk Oblast and the Republic of Karelia, which have the unified backbone network with the voltage of 330 kV (Kola nuclear power plant – Knyazhegubsky nuclear power plant – Loukhi – Petrozavodsk), with a maximum capacity[2] of about 600 MW. External inter-system connections have been formed with the Leningrad power system by a 330 kV transmission line (Kirishskaya GRES (Kirishi state district power station) – Syas – Petrozavodsk) and a 220 kV transmission line (Upper Svir hydroelectric station – Drevlyanka). A low-power connection has been established with the Vologda power plant through 110 kV power transmission lines. Electricity is exported in limited amounts to Norway and Finland (about 0.7 billion kWh).

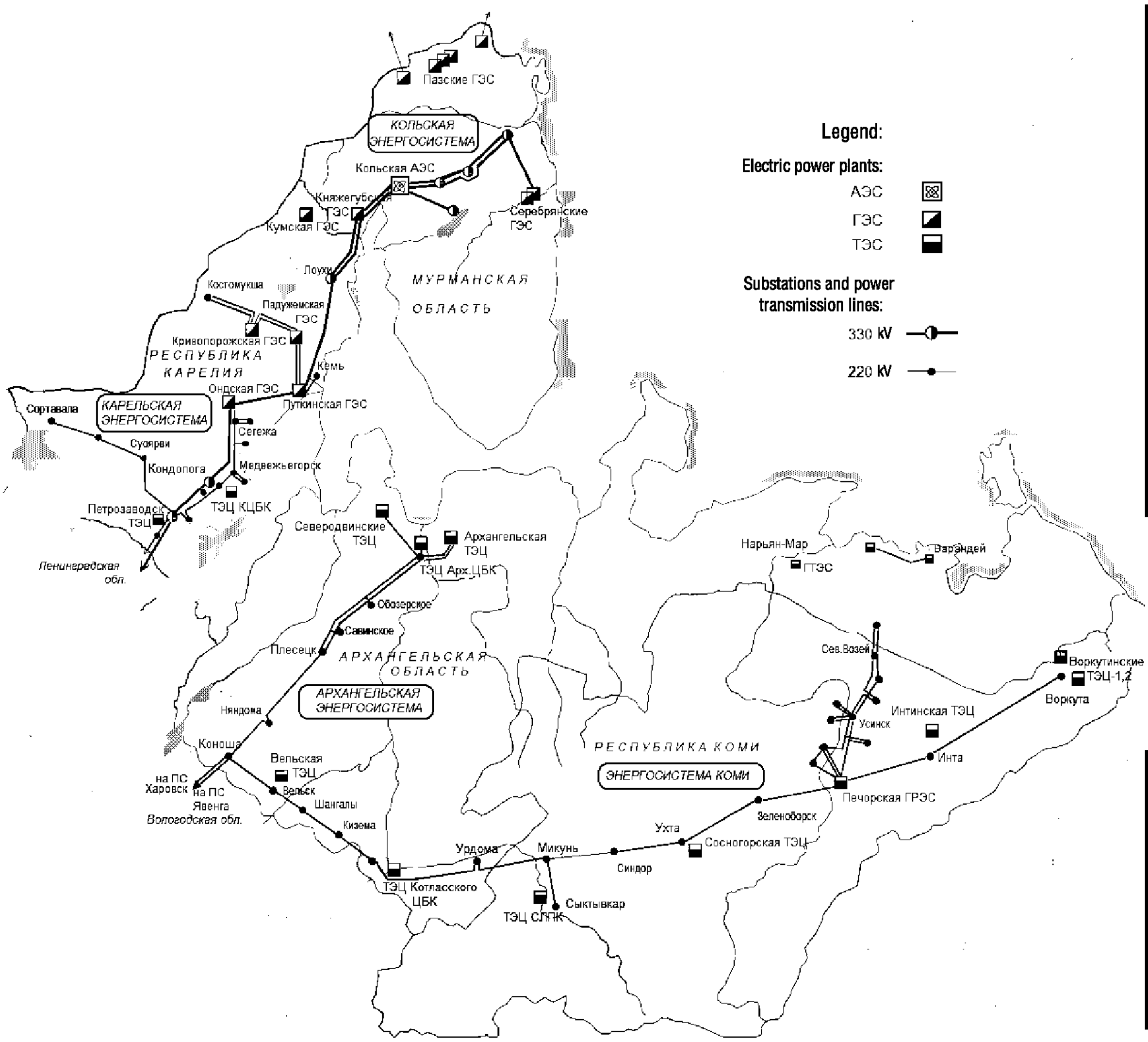
The Eastern part contains an extensive network, including power systems of the Arkhangelsk Oblast and the Republic of Komi that have a backbone connection of a lower voltage level through 220 kV power transmission lines Mikun – Urdoma (the maximum capacity[3] on the regions' border doesn't exceed 200 MW). There is an outside intersystem connection through 220 kV transmission lines with the Vologda Oblast power supply system (Konosha – Kharovsk, Yavenga), that is part of the unified electric power system of the Centre.

[1] On the territory of the regions included in the Far North and localities equated to them: the Murmansk and Arkhangelsk oblasts, the Republic of Karelia and the Republic of Komi. The Vologda Oblast power system (as part of the Northern economic area) is considered only in terms of external linkages, since it is included in the united energy system of the Centre, which establishes the priorities of its operational interaction and development.

[2] According to the data of OJSC System operator of UES: Information necessary for competitive capacity procedure for 2012 (http://monitor.so-ups.ru/?P=42&DocumentID=163).

[3] Scheme and programme for the development of power industry of the Komi Republic for 2012 – 2017: adopted by the Resolution of the Government of the Komi Republic dated 28 April 2012 No.172-r.

Figure 1. Location of the main electric power facilities of REN



The potential of the most efficient utilization of this connection for transferring the cheaper electric power from the UEPS of the Centre to the Northern part of the Arkhangelsk Oblast is limited by the transmission capacity of a single-circuit area of high-voltage 220 kV transmission lines “Konosha – Plesetsk”[4]. There are also several low-powered intersystem connections through 110 kV transmission lines with the Vologda and Kirov oblasts, but the energy supplies effected through these lines are of local importance. Energy consumers of the Nenets Autonomous Okrug and North-Eastern districts (Mezensky and Leshukonsky) of the Arkhangelsk Oblast remain outside the system of electric power industry (with decentralized electricity supply).

The analysis of Rosstat data and the official information provided by the regional administrations and energy companies allowed estimating the parameters of the energy-economic space under review *(tab. 1)* and identifying the general and distinctive features of the two formed separate parts of the electric power system of REN.

[4] Source: website of the Arkhangelsk Oblast Administration (http: //www.dvinaland.ru/ power/departments/ deptek/26145).

Table 1. Economic and power industry indicators of REN for 2010*

Indicators	In the service area	
	Western part of EPS	Eastern part of EPS
Area, thousand km^2	325	1006.7
Population, thousand persons	1441.3	2129.7
Number of cities and towns; urban-type settlements; rural settlements	29; 23; 888	24; 49; 4691
Gross regional product (GRP), billion rubles	362.3	708.2
Volume of shipped production (VSP)of industry, billion rubles	288.7	578
Structure of VSP of industry, % according to the type of economic activities (TEA): Extraction of minerals Manufacturing Production and distribution of energy, gas, water	 34 46 20	 55 34 11
VSP of TEA "Production and distribution of electric power", billion rubles VSP of TEA " Production and distribution of heat power "	33.9 22.0	32.6 24.7
Volume of electric power consumption, billion kWh, total	22.4	17.9
Including losses in networks	1.2	1.6
Domestic consumption per capita, thousand kWh/person	1.0	0.9
Electric intensity of industrial production, kWh/thousand rubles	50	20
Electric intensity of GRP, kWh/thousand rubles	59	25
Volume of electric power production in 2010, billion kWh	22.7	17.3
Net proceeds (+) or output (-) of electric power, billion kWh	-0.3	+0.6
% of the volume of production	-1	+3
Power system structure of electric power plants according to their types, MW:	4858	4464
Thermal power plants (TPP) (including those working on gas)	811 (380)	3917(2434)
Nuclear power plants (NPP)	1760	0
Hydraulic power plants (HPP)	2235	0
Stand-alone power plants (including gas-fired power plants)	52	547 (260)
System electric load maximum in % to the total generating capacity of an electric power plant	70	66
Structure of electric power output according to the types of power plants:		
TPP	11	100
NPP	47	0
HPP	42	0
Number of power plants with installed capacity over 30; 100; 1000 MW	26, 11, 1	15, 9, 1
Maximum voltage class of the grid, kV	330	220
Total number of substations with the voltage over 35 kV, units	285	396
Transformers powerf, MVA, voltage class: over 110 kV inclusive under 35 kV inclusive	 9412 1921	 6528 4529
Transmission route length, thousand km: voltage 110 kV and higher 35 kV and lower	10 10	11 45 (36)
Wholesale electricity and capacity market (WECM) zone	Price	Non-price
Average cost of electricity provided to the consumers rubles/kWh (VAT excluded)**	1.8	3.3

* Compiled on the basis of the official data of Rosstat, regional administrations, energy companies and organizations.
** Calculated as a ratio of the value of the shipped goods of foreign economic activities "Production and distribution of electricity" to the volume of electricity provided to the consumers.

General features:

1. Service area of the electric power system includes Northern territories with harsh natural conditions and low population.

2. Configuration of the network structure of an extended linear type, with the predominance of single-circuit power lines. The routes of the main backbone transmission lines are located along the railways.

3. The installed capacity of power plants in both parts of the electric power system doesn't exceed 5 GW. The available generating capacity is sufficient enough for the consumers of the considered REN regions.

4. The available excess of installed capacities in each of the parts (about 15%) is represented by pent-up capacities, the use of which is limited by the capacity of the backbone network transmission.

5. Long-term exploitation of most power plants (40 – 70 years).

6. The volume of power and energy exchange through interconnection lines among other neighbouring regions (the Leningrad, Vologda, Kirov oblasts) is insignificant, mainly due to technological limitations.

7. High depreciation of electric power distribution networks.

8. The cost volumes of markets of electric and thermal energy are rather similar.

The two parts of REN EPS differ in the following aspects.

- The service area of the Dvina-Pechora part covers a significantly large territory with a more dispersed settlement structure. Here the macroeconomic efficiency of social production is higher mainly due to the prevalence of oil and gas sector in economy. But the utilization capacity of electricity is lower both in absolute and in specific indicators (per capita, per unit of GRP). The Karelian-Kola part contains industrial production that consumes more electricity: specific consumption of electric power in 2010 on average amounted to 50 kWh per 1 thousand rubles of shipped products, which is 2.5 times more than in the Eastern part.
- The structure of installed capacity and generation at the power plants of the Dvina-Pechora part is uniform and includes only thermal power stations operating on organic fuel, and using gas as a fuel for 60% of their capacities; about 60% of electricity is generated using the fuel produced in the region of its utilization. In the Karelian-Kola part of EPS, the structure of generating capacities is diversified: energy is produced by nuclear, hydro – and thermal power stations, and non-fuel power production, concerning its capacity and performance, significantly exceeds thermal power production, which is more expensive and operates on imported fuel.
- The electric power industry of the Western part of REN, unlike that of the Eastern part, is characterized by the less sparse and concentrated location of power producers: in a much smaller service area, the system has a greater number of operating electric power stations, less distant from each other. A more uniform and high density of generation is a factor that enhances the reliability and efficiency of centralized power supply. Each part of the electric power industry of REN contains one GW-class power producer: the Kola nuclear power plant and the Pechora state district power station (SDPS).
- The REN EPS power network has the following voltage classes: the backbone 330 kV and 220 kV power transmission lines connect the centres of generation and carry out transit (long-range) power transmission; 150 kV and 110 kV power transmission lines are backbone distribution lines, connecting main power centres with main load concentration points; transmission lines of 35 kV and lower are distribution lines in urban settlements, rural areas and at enterprises. As the data in *table 1* shows, the system-forming network of the Western part of REN EPS is more high-powered: it is formed by transmission lines of a higher voltage class and has a larger quantity of transformer capacities than the Eastern part.

The total length of high-voltage transmission lines in both parts of EPS is practically the same, while the coverage area and length of the main transit in the Eastern part is 2 times larger. The volume of development of low-voltage distribution networks in the Eastern part of REN EPS is 4 times greater than that in the Western part, which is explained by the low density and the dispersion of consumers in the service area three times as vast.

- Economic efficiency of electricity supply varies due to the above features of technological structure of the two parts of REN EPS: the average cost of power supply is 1.8 times higher in the Eastern part. It is the result of firstly, a more expensive fuel generation, especially working on fuel oil; secondly, higher unit costs of operating the network distribution complex, because more substations and power transmission lines are involved in distributing a smaller amount of energy. The price ratios of the unit value of different generation types, calculated on the basis of approved two-rate tariffs on energy and capacity for suppliers of the wholesale electricity and capacity market in 2010 [12] show the price advantage of the non-fuel generation in the Western part of REN EPS *(fig. 2)*.

The ratios of the cost of power production to its transmission services, established in REN EPS, considered on the example of the structure of prices for electric power for industrial consumers of the regional retail markets (excluding population) with the number of hours of using the declared capacity being 5,000 hours/year *(tab. 2)* indicate that the value of network services exceeds the generation prices and they are higher in the Eastern part of the power system.

- Institutional conditions of regulating power supply activities in the considered parts of REN EPS have differences, which are

Figure 2. Production volume of wholesale market suppliers in REN EPS and tariffs on the power, 2010

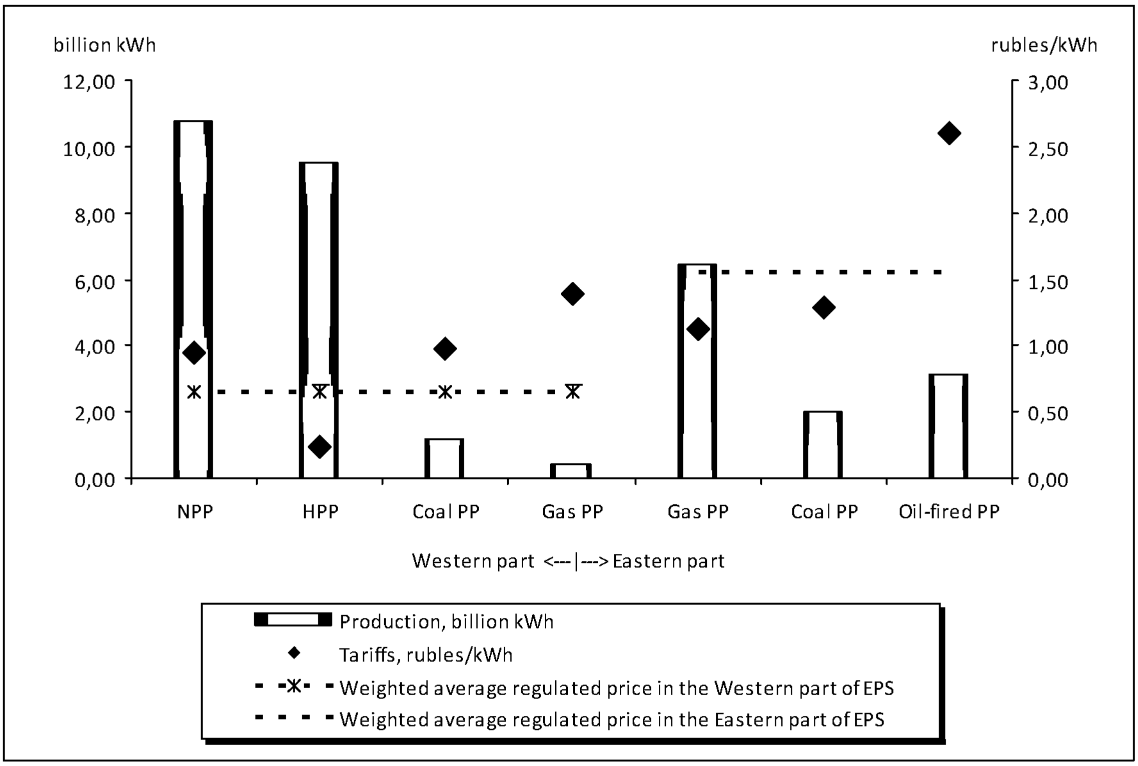


Table 2. Electricity prices and tariffs as of 2010, rubles/kWh, VAT excluded*

Price constutuents	On retail electricity markets			
	Murmansk Oblast	Republic of Karelia	Arkhangelsk Oblast	Komi Republic
Cost of generation: tariff	1.06	1.10	2.02	1.47
open price	1.52	1.64	-	-
Tariff on transmission services when supplying electricity within: high-voltage (HV) network	1.84**	1.62	1.58	1.76
low-voltage (LV) network	1.84	1.96	3.42	2.35
Sales premium and infrastructural payments	0.03	0.12	0.12	0.11
Total price HV/LV:: regulated (tariff)	2.94 / 2.94	2.84 / 3.18	3.73 / 5.57	3.33 / 3.93
open	3.39 / 3.39	3.37 / 3.72	-	-

* Calculated on the basis of two-rate tariffs and prices, according to the official data of regional administrations and marketing companies.
** Equality of HV and LV tariffs indicates tariff cross-subsidization for consumers connected to a LV network, at the expense of customers in a HV network.

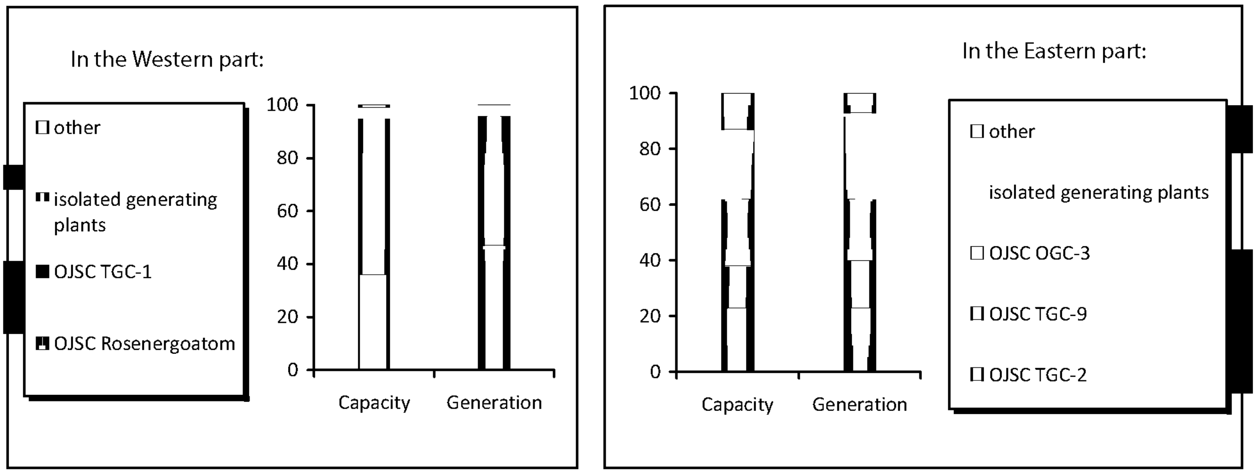
revealed when considering the wholesale electricity and capacity market (WECM) from the viewpoint of price and non-price zones. It is supposed, that the price zone of WECM (the Western part) has the conditions of a competitive market in electricity generation, and in the non-price zone (the Eastern part) competition is limited by technological conditions.

Accordingly, the generating companies in the price zone carry out their activities in the liberalized segment of the market with free pricing, and in the non-price zone – under the conditions of tariff regulation. *Figure 3* presents the main subjects of generation and the share of their production in the appropriate market areas. In the Western part of REN EPS, there are only two major generating companies on the market, but even between them competition is not possible due to the normatively established technological priorities for loading the capacities of a nuclear power plant. In the Eastern part, the number of market participants and their share in production allow the development of competitive relations, but they are hampered by the network restrictions and costs of power and energy transfer from distant sources.

Therefore, full-fledged competitive market relations between generating companies in both parts of REN EPS currently can not be realized. Nevertheless, the rules regulating the activity in WECM price zone create advantages for efficient generators. The procedure of competitive selection in WECM implements the principle of marginal pricing, which allows generators with low operating costs get higher revenues, than under the conditions of tariff regulation according to economically justified costs and revenues.

As the data in figure 2 and table 2 show, in WECM price zone (Western part), the open price for electricity (with regard to power), which has been formed at the level of the tariff (i.e. economically sound cost of production) of the supplier is about 1.5 rubles/kWh, which is considerably higher than the tariffs of nuclear and hydroelectric power stations, which ensures their high profitability. Official accounting reports of power companies indicate, that in 2010 the profitability according to EBITDA in the price zone accounted for more than 50% at Rosenergoatom and 25% at TGC-1, in the non-price zone at TGC-9,2 and OGC-3 it didn't exceed 6%. For energy companies, such differences in price regulation

Figure 3. Structure of electric power production according to the main subjects of REN EPS



of their profitability should undoubtedly affect motivation and the formation of investment resources for modernization of their own production capacities. For consumers, the differences in price regulation resulted in the outpacing dynamics of the rise in the cost of energy in the liberalized segment of WECM, as a result of which the average price level of the retail markets in the Western part of EPS, with non-fuel generation more efficient according to operational costs, approached the more expensive one – in the Eastern part.

Problems and prospects of spatial development of REN EPS

The analysis of the spatial organization of REN EPS allows the following main conclusions to be made.

Electric power supply system in Russia's European North consists of two self-contained parts; there is only an indirect connection via the unified electric power system of the Centre, with no integration purposes. Both parts of EPS are included in the North-Western unified electric power system, but for the Eastern part, consisting of Arkhangelsk and Komi power systems, this union is formal, since there is no technological connection for the system interaction with other objects of the unified power system. In the Western part of EPS the integration is provided by the power supply network connections between the Kola and Karelian power systems and the Leningrad EPS.

System generating capacities in both parts are sufficient for fulfilling the present-day requirements of economy and population in their service areas. Each part of EPS has some excessive reserves of generating capacity, which are planned to be used in the 5 – 10-year perspective for connecting new consumers and replacing retired capacities. Therefore, the task of developing external economic relations with the aim of further transmission and expansion of electric power market is not relevant at present. A more differentiated and efficient generation system with a more powerful backbone connection has been formed in the Western part.

The primary task of spatial development of REN EPS is the "strengthening" of the established basic structures with the purpose of organizing technically and economically optimal interaction of energy facilities. In this respect, the programmes for the development of electric networks [10, 13, 14] envisage the elimination of "bottlenecks" in the system-forming connections – the construction of second chains of transmission lines for increasing transmission capacity and transmission reliability, reducing losses and total costs of electric power supply when using the most cost-efficient facilities.

Since the efficiency level of electric power industry in the Eastern part of Russia's European North is considerably lower than in the Western part, it is expedient to enhance its efficiency: 1) by replacing expensive fuel; 2) by developing and strengthening the backbone connection; 3) by introducing the sources of non-fuel generation (nuclear or dispersed hydro- and bioenergy). The first two directions are already being implemented: combined heat and power plants (CHPP) working on fuel oil are being modified to work on gas, construction of the second networks of 220 kV system transmission lines. The creation of an efficient power source on the basis of coal fuel is viewed as a strategic goal in solving the problem of diversification of utilized fuel.

Technological integration of the two parts of REN EPS into a single complex can be grounded by the following factors: 1) enhancement of energy security, since the system integration will promote the diversification of energy sources structure according to the types and resources, neutralizing potential threats of gas being the major resource orientation of electric power industry in the Eastern part; 2) reduction of the cost of power supply through optimizing the load and power exchange in order to use the most efficient energy sources to the fullest; 3) increase of reliability of power supply of the consumers given the increase in the number of acceptable supply alternatives; 4) adjustment of price differences; 5) development of competitive relations by increasing the number of market participants. The unification of the two parts of REN EPS is possible by creating a direct inter-system connection (for example, a double transmission line 220 along the route Obozerskoye – Belomorsk – Kem).

The relative isolation of the Arkhangelsk and Komi power systems can be handled by the development of network connections with the power systems of the Vologda and Kirov oblasts. But both these systems are not sufficiently provided with their own generating capacities, the lack of which is covered by considerable inter-regional supplies from the unified energy system of the Centre and that of the Urals. Therefore, the development of system connections of the Eastern regions of Russia's European North in the southern direction depends on the maximum capacity of transit and competitiveness of transferred energy.

A decision on the expediency of uniting the two parts of REN EPS can be made only after pre-project feasibility studies in the framework of the system planning of Russia's unified energy system development. Such studies are carried out under the direction of federal bodies (the Ministry of Energy of the Russian Federation, OJSC System operator of UES) by the leading developers of strategies and programmes on the prospective development of the national UES of Russia (Institute of Energy Strategy, JSC G.M. Krzhizhanovsky Power Engineering Institute, Energy Research Institute of RAS, Melentiev Energy Systems Institute of the Siberian Branch of RAS, CJSC Energy Forecasting Agency, etc.), which have the necessary information, methodological and modeling tools.

According to Russia's EPS development projects for the period up to 2020, included in the officially approved documents [13, 14], the spatial structure of REN EPS will not undergo significant alterations. The relative isolation of the Eastern part will be maintained (given the formal inclusion in the UES of the North-West), the structure and capacity of energy sources will not change significantly, the regional and inter-regional system network connections between the Arkhangelsk and Komi energy systems will strengthen, the capacity of intersystem connection with the Vologda Oblast for the power transit from UES of the Centre will increase. As for the Western part, it is planned to increase the capacity of the Kola – Karelian – Leningrad EPS backbone connection, and the substantial growth of nuclear energy potential is envisaged as well, with a significant surplus of generating capacity in this part of UES of the North-West exceeding the standardized reserves. Therefore, the planned development will lead to the increase in the differences in the potential of electric power economy in the parts of EPS under consideration.

In conclusion it should be emphasized that one of the objectives of spatial development of economy and power industry is to reduce inter-regional disparities[5], which implies rational alignment of living conditions, including energy supply: its availability, quality, reliability and efficiency. Thus, the plans and projects for energy infrastructure modernization should ensure balanced spatial development.

It is difficult to determine to what extent this requirement is maintained, since the main programme (federal and regional) documents on the development of electric power industry don't contain, with few exceptions, the forecasts of future conditions – indicators of reliability, security, energy, environmental and economic efficiency, which served as the criteria for the decisions taken. Meanwhile, no doubt, that assessing such targets in the planning of spatial development is extremely important not only for the macro-level of national power industry, but also for its established meso-structures and regional segments. The compulsory character of assessing the criterial indicators reflecting the efficiency of various segments of the spatial structure of energy economy will serve as a basis for the rational direction of efforts and resources to "weak" objects and relations, it will also promote quality monitoring and control over the efficiency of the system design and programme management.

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