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Power Sector Reform and Electricity Market Development in Russia

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ABSTRACT: Each country is concerned about the efficiency of their internal power sector. The sector management and Government structures endeavor to apply positive experience gained by other countries, taking into account technical and economic conditions of their own power sector. The paper describes the main characteristics of power sector in Russia, as well as the the concepts of the power sector restructuring and market organization. Urgent trends in the electricity and capacity markets development are described. Current problems and the necessary measures for its overcoming can be helpful for other countries developing modern electricity markets.

KEY WORDS: Power sector, Power sector reform, Regulatory framework, Electricity market, Capacity market, Current problems

I.INTRODUCTION

Reforms of electric power sector in many countries have become an important policy trend over last three decades. Successful reform implementation provides an improvement of national economy indicators and quality of power supply.

The main elements of the reform in different countries consist of structural conversion of electric power companies, revision of regulatory framework and adaptation of infrastructure bodies, design and introduction of new market principals and mechanisms for commercial cooperation. The reforms are focused on enhancement of energy trade and security, financial viability of energy supply entities, social protection of customers, and cooperation in international energy resources utilization. The choice and sequencing of the reforming measures depend on the economic situation and urgent aims in each country. Similar approaches and actions toward market modernization should be adapted to the institutions existing in each country.

The scenarios of reforms rely on different assumptions about regional and global economic growth, technological developments, market behavior, and energy and climate policies. Since political and policy developments are much unpredictable, there is wide outcome space of ways for power sector modernization. Despite the notable progress in national power sectors reforms, challenges remain.

Following the positive market experience of some developed countries can help to enhance the national economic climate in countries with still immature markets. Implementation of such experience can accelerate introduction of new and development of existing markets.

Reforming the power sector and transforming the electricity market are the key efforts in the Russian since early 90s of previous century. As it was the case in many countries, Russia's power sector was based on vertically integrated state-controlled regional power companies. The problems of cross-subsidies and lack of competition among power suppliers encouraged industrial and State authorities to introduce competitive electricity and capacity markets. Deregulation of relationships in generation and supply sectors was directed at creation the competitive environment, stimulation efficiency enhancement, and set the fair electricity prices for consumers.

This paper gives an overview of the Russian electric power sector characteristics, describes the market organization, and discusses the unsolved problems in the market organization. Current activities for the future sector modernization can be helpful for the improvement of electricity markets in other countries.

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II. LITERATURE SURVEY

The approaches to liberalization of the electric power industries were appreciably different in the various countries. The reforming experience and effects depended on economic and technological characteristics of the industries, evolution in regulatory systems and a variety of ownership structures. Since monopolies frequently resulted in the price rising, governments accepted two basic models for the electric power industry: 1) Industry is the State integrated monopoly, and 2) Industry combines regulated private companies. Many countries (e.g. Ireland, France, Greece and Italy) consolidated and nationalized their electric power industries as State monopolies, supposing that State companies will operate in the public interests instead of maximizing their profit. In Germany there were regional State monopolies, as a variant of the first model. The second model of the sector organization was chosen in the USA and Japan, where private companies were regulated on the basis of production costs and profitability of investment capital [1].

In those countries that included privatization in their plans of reform, the order of privatization and liberalization also varied. In England and Wales privatization preceded liberalization, whereas in the Scandinavian countries liberalization preceded a partial privatization. As a whole, however, there is a tendency to privatize the generation and selling of electric power, both through active programs of sector privatization and through market access for new private generating companies [1].

The driving forces for the sector reforms in developed and developing countries were different. In developed countries, the main aim of the reforms was to improve the performance of relatively efficient systems. Developing countries had to reform less efficient electricity systems with less developed private sectors, weak economic and political institutions [2]. Against negative background of many developing countries, a new standard model for power sector liberalization was formulated [4]. P.Joskow in [3] noted that realization of the standard model included several identical steps. There were clear pre-requisites for introducing wholesale and retail competition, also known as the culmination of the standard model [3, 4].

Following generally the standard model, the liberalization process is successfully developing in China [5]. The main steps of the standard model are extended in China by additional elements appropriate to a low carbon transition, which involves subsidies in lower carbon generation technologies [6] Main elements of the Chinese sector reform are based on: market restructuring and ownership changes; supportive secondary market arrangements; appropriate economic regulation; and, efficient promotion of low emission technologies.

Reforms in the developing non-OECD[1] countries in Asia were implemented in spite of chronic electricity shortages, weak institutional capacity, and complex political factors. Consequently, the viability of the standard model for Asian developing countries was debated extensively [4, 7, 8]. It was postulated that restructuring towards greater competition can improve technical performance, maximize economic welfare and transfer surplus to consumers [9]. Authors of [7, 10] submitted the results of investigation on the effectiveness of the standard model for non-OECD countries in Asia.

III. THE ELECTRICITY POWER ECTOR IN RUSSIA

Russia has a unique electric power system which supplies consumers with electricity on a vast territory covering 10 time zones. The transmission network spans almost 4000 miles from east to west and helps to reduce the demand peaks in winter.

The electric power system consists of interconnected (unified) and disconnected parts. More than 90% of generation capacities run synchronously. Off-grid electric systems are operated on the Russian Far East and on some north territories of the country.

According to the annual report of the System Operator the installed capacities of power plants in the unified part of the system reached 239.8 GW in 2017. Most of the generation capacities (67.9%) are concentrated at the thermal-electric power plants with fossil fuels, hydro-electric plants have 20.2% and nuclear power plants 11.6% of the total installed

[1]Organization for Economic Co-operation and Development (OECD) includes 36 member countries.

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capacity. Renewable energy sources supplemented 0.3% to total generation capacity. Total electricity production in Russia amounted to 1091 bill. kWh including 1053.9 bill. kWh in the unified part. Thermal-electric plants produced 63.7% of the total electricity production, hydro-electric plants produced 17%, and nuclear power plants 19.3%.

The majority of existing thermal power plants in Russia run on fossil fuels such as natural gas, coal and fuel oil. Proportions of the different kinds of fuel utilization in 2017 were: - natural gas 72.7%, - coal 25.6%, and - fuel oil 1.7%. Total electricity consumption was 1039.9 bill. kWh in 2017. The peak value of consumed power was in January 2017 and amounted 151.2 GW. Installed generation capacity (239.8 GW) exceeded peak value of total electricity consumption (151.2 GW) by 88.6 GW or 58.6% of consumed power.

One of the important areas of the Russian EPS activity is the pursuit of an effective foreign trade policy. Electric power system of Russia has transmission links with a number of neighboring countries. Among them are participants of NORDEL Pool (Norway, Finland) the Baltic countries (Lithuania, Estonia, Latvia), the countries of the Caucasus region (Azerbaijan, Georgia, South Ossetia, Abkhazia), countries of Middle and East Asia (Kazakhstan, China, Mongolia). Directions and amounts of export-import of electricity in 2017 are shown in Fig. 1.

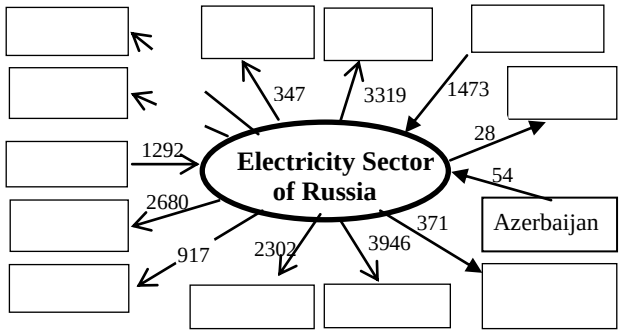

Fig. 1. Export-Import Transfers of Electricity in 2017, bl. kWh

Most of generating assets are concentrated in 6 wholesale generation companies (WGCs). Five of them maintain thermal electric power plants. Each of thermal WGC (except WGC-2) contains 9-10 GW of generation capacity and combines 5 or 6 high-power thermal electric plants. WGC-2 operates 11 thermal power plants and has installed capacity almost 19 GW. The Federal hydro-electric generation company ("RusHydro") operates more than 60 hydro-electric and pumped-storage plants. The power plants for WGCs were selected so as to limit the possibility of exercising market power in electricity markets. Thermal power plants with combined (heat and electricity) production are combined in 14 territorial generation companies (TGCs). These companies consolidate power plants within neighboring regions, and produce both electric and thermal energy, while WGCs generate mainly electric power. Nuclear electric power plants in Russia are maintained and operated by the state-owned concern "RosEnergoAtom".

Operation and development of the transmission and distribution networks are coordinated by the Federal grid company "Rosseti". This company includes Federal Network Company which operates high-voltage transmission networks and Distribution Grid Holding for operation and development of regional medium-voltage distribution networks.

Planning and dispatching of the power system states, as well as fail-safe functioning of the electric system provides a joint-stock company named System Operator (SO) of the Electric Power System of Russia.The regulatory services in the electricity sector are carried out by several Government controlled structures. Among them are: the Ministry of Energy, which is responsible for the implementation of State policy in the electricity sector and for the elaboration of regulatory acts for that purpose; the Federal Tariff and Antimonopoly body, exercising control over price regulation and control of the natural-monopoly businesses; the Federal body for Ecological, Technological and Nuclear Supervision.

Participants of the electric power sector have different structure of property. Companies with the natural-monopolistic businesses like the Federal grid company, System Operator, the Federal hydro-electric generation company, concern

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"RosEnergoAtom" have State domination in property. Foreign companies invest their money in the generation sector with thermal power plants. Among active foreign investors are E.ON Concern of Germany, ENEL of Italy, FORTUM Co. of Finland, and Integrated Energy Systems Ltd. of Cyprus.

The regulatory services in the electricity sector are carried out by several Governmental structures. The Ministry of Energy is a regulatory authority responsible for the implementation of state policy in the electricity sector and for the elaboration of regulatory acts for that purpose.The Federal Tariff and Antimonopoly Service is an executive body exercising control over price regulation (for example, tariffs for transmission services or residential tariffs). It also regulates natural monopolies, where its functions encompass price (tariffs)determination. The body can issue mandatory orders or penalties to the companies violating the anti-monopoly regulations in the electricity sector.

The Federal Service for Ecological, Technological and Nuclear Supervision is a regulatory body responsible for implementation of and monitoring the compliance with the health, safety and environment requirements.

IV. REFORM OF THE ELECTRICITY POWER SECTOR

The spread of the power sector reforms across both developed and developing countries has become an increasingly important policy trend over the last three decades. As it was the case in many countries, Russia's electricity sector was dominated by a vertically integrated, state-controlled monopoly up to early 1990s [11]. The problems of ageing infrastructure, large distribution losses, low retail tariffs, and lack of market incentives to reduce production costs encouraged Russia to embark on reforms to liberalize the power sectors in the 1990s.

Liberalization of the Russian electricity sector has continued for almost 25 years. At the first stage (1992-2003) State property of the regional power utilities was privatized.A wholesale and regional retail electricity markets were launched in 1996. According to a chosen market model power producers sold electricity to a single buyer [11]. The prices in the electricity sector were fully regulated by the State regulating entities. Most of the utilities bought electricity from the single buyer under annual contracts. Regional utilities supplied their assigned customers without any competition at an average price regulated for certain territory.

A new stage of the sector liberalization lasted from 2003 up to date. The State and sector legislation was renewed substantially. Federal laws were passed or corrected. A number of Government resolutions were issued for market organization. Numerous special regulation acts were applied to the nuclear power and hydropower utilization and generation efficiency improvement. The new legislative base defined main directions for necessary changes and declared the competitive relationships in the sector as a main instrument for efficient and stable electricity supply.

The restructuring process of local power companies' was launched in 2003. Vertically integrated regional utilities were unbundled into separate companies for generation, transmission, distribution and supply businesses. Newly established companies surpass former regional monopolies. Generation and supply sectors were considered as competitive businesses. Transmission and distribution services were classified as regulated natural-monopolistic businesses. Deregulation of generation and supply was aimed at creation of competitive market environment, motivation for efficient production of electricity, and attraction the strategic investors to the Russian power sector.

The wholesale electricity market was transformed into the market with competition among generation companies. Administrator of the Trading System (ATS) was established as a non-profit entity for the wholesale market design and operation. Locational marginal prices were introduced for the wholesale buyers. The prices at the electricity market were gradually liberalized. Currently about 80% of electric power is traded at non-regulated market prices [12]. Regulated prices are used for supply electricity to the household customers only.

V. OVERVIEW OF THE ELECTRICITY MARKET IN RUSSIA

The market framework in the Russia's electric power sector consists of the Federal wholesale and the regional retail markets.

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New companies such as WGCos, TGCos, and State-owned nuclear power plants are producers in the wholesale market. Producers have the right to enter the wholesale market if their capacity is not less than 25 MW. Local electricity suppliers and large end consumers buy electricity. Currently, end consumers with demand capacity of 20 MVA and more are able to buy electricity in the wholesale market. Federal Grid Company, SO and Administer of Trading System provide infrastructure for the wholesale market. Prices of the infrastructural companies are regulated. According to [13], 95 % of the produced electricity currently is sold in the wholesale market. Competition level is high among producers [13].

Because of great distance for electricity transmission the wholesale market is divided in to two large price zones (1 and 2) [14]. Fig. 2 shows that the first price zone includes the territory of the European part of Russia and Ural region. The second price zone covers Siberia.

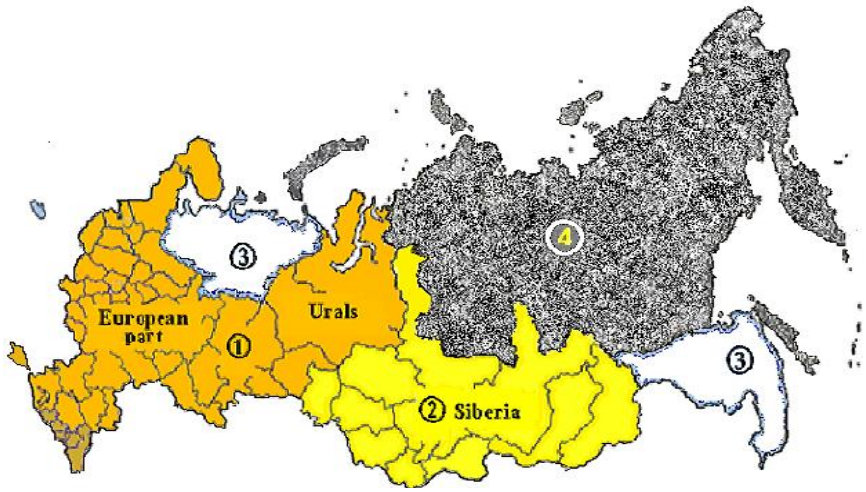

Fig. 2. Price zones of the wholesale market (1 and 2), non-price zones (3), off-grid power system (4)

Not all territory involved in the wholesale market trade. Besides the wholesale price zones there are two territories (non-price zones) where currently do not exist necessary conditions for the market competition. Electricity within the non-price zones is traded at regulated tariffs [14].Electric power systems in the North-East part of the country are disconnected from entire Power System. These off-grid power systems are not involved in the competitive wholesale trade. Electricity is also supplied at regulated prices.

Two commodities are traded in the wholesale market: electricity and capacity. The cost of electricity is based on the amount of consumed electricity, while the cost of the capacity is defined according to the consumer peak demand in a month.

The wholesale electricity market includes several forms of trade (segments): the regulated contract (RC) segment, the free bilateral contract segment, the day-ahead market (DAM) and the balancing market.

The regulated contracts are used for the electricity supply to the population. Prices (tariffs) under RCs are set by the federal and local executive bodies responsible for tariff regulation. Electricity volumes not covered by RCs are sold at non-regulated prices through other segments.

Under Free bilateral Contracts, market participants choose their own counterparties, contract period, prices and schedule of supply volumes. In the day-ahead market (DAM) suppliers and consumers are selected on a competitive basis a day before actual electricity supply is to take place. Offer prices of producers are not regulated. Selection of bids is carried out by the administrator of trading system, with prices and supply volumes being determined for each hour of next day. Locational marginal pricing is used at the DAM. The locational prices are determined for each of the roughly 8000 nodes in both price zones and are published daily on the trading administrator's website. The DAM operation

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needs the development of a modern numerical measurement system. Considering the vast territory of the country, this is a complicated technical problem.

Electricity volumes traded under bilateral contracts and at the DAM determine the forecasted consumption of electricity. However, the actual consumption (or generation) often differs from the forecasted volume. Trade in deviations from forecasted production or consumption amounts is carried out in real time at the Balancing Market. The System Operator makes an additional competitive selection of suppliers' bids, considering cost effective providers and system reliability requirements. The Balancing Market penalizes the market participants responsible for the deviations on their own initiative and rewards the participants that are accurate in fulfilling the System Operator's orders. Shares of electricity sold in different sectors of the wholesale market are shown in Table I.

Table I. Amounts of electricity sold in sectors of the wholesale market, 2017, %

	Day-ahead market	Regu-lated contracts	Free bilateral contracts	Balancing market
The first and second price zones	71.6	18.9	4.0	5.5

The market for electric capacities is based on a competitive capacity selection (CCS) made by the System Operator. Not all available capacity is selected through CCS, thus increasing competition between capacity suppliers. Capacity trade imposes the obligation of generating companies to maintain a certain level of generating capacity. Capacity not selected at the CCS is not paid for, except for the capacity of generating facilities that must run in order to support the power system's technological requirements or to supply consumers with heat ("must-run generators"). The capacity of the "must-run generators" is paid for at the individually regulated tariffs.

There are two kinds of capacity markets in Russia. An annual one selects bids submitted for each month. A Long-term market selects generation capacity for 4 years ahead. Long-term market guarantees the suppliers for getting the capacity payments during the construction of new generating facilities. Competitive capacity selection in the long-term market is conducted based on the System Operator's demand forecast for the relevant delivery period.

Retail electricity markets were organized with several competing supply entities in each region. The main participants in the retail markets are electricity consumers, power suppliers (retailing companies), distribution companies and other owners of network facilities that provide distribution services, and generators that do not have the right to participate in the wholesale market. End consumers in the retail market can choose a supplier and conclude a direct contract for electricity delivery.

Electricity and capacity prices for retail customers depend on the situation in the wholesale market. Prices may fluctuate following price changes at the day-ahead market. The residential tariffs established by the regulating entities, however, remain to be stable

VI. URGENT TRENDS IN THE ELECTRICITY MARKETS DEVELOPMENT IN RUSSIA

Achievements in the Electricity sector reform in Russia are impressive. Former regional vertically integrated monopolies have been unbundled and privatized. The wholesale and territorial generation companies have been assembled. The wholesale and retail markets for electricity and capacity have been established. The government retains control of transmission and most of distribution network companies, the system operator, nuclear and hydro power generation. The balancing market compensates deviations in consumed and generated energy from forecasted amounts. The capacity market provides sufficient commissioning of new generation facilities.

However, there remains a set of challenges affecting the efficiency of competitive wholesale and retail markets in Russia. The challenges relate to market design, competition support, pricing, investment provision and existing regulation. Elimination of negative market features defines urgent trends in markets development and modernization. The evident problems of the Russian markets are the following:

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1. There is insufficient competition within retail electricity markets. Several independent private supply companies were established in each region. They are supposed to compete for the end consumers by lowering the price of their services and offering more profitable and convenient conditions for electricity supply. At the same time, suppliers of last resort (commonly referred to as Guaranteeing Suppliers (GS)) were established to supply customers and to fulfill universal service obligations, including supplying customers served by an independent retailer within their franchise. Each GS is subject to regulation supervised by national and regional regulatory authorities.

Theoretically, end consumers have the right to choose any supplier, from each they are going to buy electricity at free unregulated prices. In practice, each GS is permitted to operate an exclusive local franchise, in which they are the only entity that can supply residential customers. GS's possess a dominate market position in most retail markets in Russia, accounting for between 75% and 85% [15] of all retail sales across the power systems where competitive markets are being introduced. Retail customers have no possibility to choose an effective supplier. The competition among retailers is weak due to a monopoly position of one of them.

In addition, according to the wholesale market regulation all electricity producers with the installed capacity of 25 MW or more have to sale electricity only in the wholesale market. Retail customers cannot enter into direct contracts with local power plants. Local power plants have to sale electricity to the wholesale market. The prices of local power plants are increased by series of additions. Among them: tariffs for electricity transmission, tariffs for activities of the System and Commercial operators and tariffs for services of the local supply companies. The prices in the retail markets have artificial overvaluations. Increased electricity prices enforce some customers to refuse buying electricity from centralized regional power systems. They provide electricity supply from own decentralized generators.

To eliminate the drawbacks of the electricity market organization it is necessary:

- to increase the number and functions of the independent supply companies. To provide the opportunity for the some network companies to perform the functions of retailers;
- to remove the existing requirement for mandatory sale of electricity generated by the plants with capacity of 25 MW and more only in the wholesale market. Local power plants should have opportunity to sale electricity both in the wholesale and retail markets. This will allow the retail consumers to buy electricity from local producers and will reduce retail prices.

2. Electricity and capacity market in Russia contain obsolete generation equipment. The State Strategy for Electricity sector development up to 2030 [16] was formed in 2008. Annual growth of total electricity consumption in the country in 2005-2008 was 2.75%. Proceeding from existing experience, very high annual growth of electricity consumption (3.1% in the maximum scenario and 2.2% in the base scenario) was forecasted for coming years starting from 2009 up to 2030. According to the document, the volume of installed capacity in Russia is forecasted to reach 311.55 GW by 2030 if demand increases according to the base scenario.

The decision was made to develop generation sector significantly to meet expected growth of electricity consumption. A capacity remuneration mechanism was introduced for the new power plants in 2010, called Capacity Delivery Agreements (CDA), in order to induce the long term investments in the generation sector. Such agreements guaranteed return on laid-down capital for investors in ten years for conventional power plants. Similar agreements were introduced for hydro and nuclear power plants, which guaranteed return in 15 to 20 years. In return, investors were obliged to build and deliver the capacity by an agreed deadline; otherwise they would have to pay fines for not delivering on time [17].

However, Russian gross domestic product fell by around 8% in 2009 in the wake of the global financial crisis [15]. Falling domestic economic activity was reflected in a reduction in electricity consumption of around 4.6% in 2009. Annual demand growth has been less than forecast, and even negative in 2013.

Maximum demand reached 147 GW in 2013, which is about 65% of installed generation capacity. Consumption values remained at low levels and only began to rise as the economy began to grow slightly in 2010 [15]. Nevertheless, commitment to the planned changes in the generation sector remained strong, and the Russian Ministry of Energy provided support for the introduction of new capacities. In total, 30 GW of new capacity under CDAs should be commissioned in 2007-2017. According to the annual report of the System Operator installed generation capacity

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(239.8 GW) exceeded peak value of total electricity consumption (151.2 GW) by 88.6 GW or 58.6% of consumed capacity.

The capacity price is determined for one year at a Competitive Capacity Auction (CCA). Power plants participating in the CCA make their bids with monthly volumes of their available capacity and acceptable capacity prices. Some of them cannot be selected in the auction because of their high capacity cost. Very often such kind of power plants requests a status of the "must-run" generator. This status can be given to generators whose work is necessary for the power system operation and reliability. In addition, required heat production of the thermal power plants is a further reason for "must-run" capacity.

"Must-run" capacities are often old generation devices with low efficiency and high operation and maintenance costs. Capacities under CDAs participate in the capacity auction with zero prices and have to be selected. Therefore the capacity auction price is formed by the not the most efficient generators, and if there is still demand it is covered by expensive "must-run" capacity.

The consumer capacity price is calculated as the weighted average of the costs of new capacities under the CDAs, the auction price and regulated tariff for "must-run" generation. In other words, the burden of obsolete capacities of new generators and expensive "must-run" generation is distributed among consumers. While electricity and capacity for the population is traded through regulated contracts, industrial consumers have to bear the additional burden of the excessive generation. The Program of the Capacity Delivery Agreements is completing in nearest two years. The Ministry of Energy is going to reduce amount of obsolete generation down to rational size.

3. Existing electricity market legislation in Russia provides for ineffective participation of the combine cycle thermal power plant in the wholesale electricity and capacity markets.Almost 68% of the total generation capacity in Russia is concentrated at thermal-electric power plants, and 40% of total capacity installed at combine cycle (cogeneration) power plants (CPPs). Cogeneration means the simultaneous production of electricity and heat. Cogeneration enables fuel savings of anywhere from 10 to 20 percent compared with the separate generation of heat and power [18].

CPPs produce not only electricity together with heat energy. Some part of electricity is generated in condensing cycle. This is cycle of solely generation of electric power. Amount of condensing generation depends on the equipment configuration of the power plant and on the amount of heat supply. The less of supplied heat, the more of condensing electricity is generated at the CPP.

Unfortunately, the existing procedure of fuel cost sharing between heat and electricity production at CPPs does not allow assign correctly the prices for electricity generated in combine and condensing cycles. As a result CPPs submit their bids for the wholesale market with the prices corresponding to generated condensing electricity.

Cogeneration power plants have more complex equipment and more compound technological processes. Cost of condensing electricity generated at CPPs is above the cost at large condensing power plants. Therefore price bids of the CPPs are at a disadvantage during competitive selection of bids in the day-ahead electricity market. For support the competition CPPs are reluctant to reduce bid prices for electricity and boost prices for heat. High heat prices encourage commercial customers to refuse the buying heat energy from centralized system and to build their own boilers. Many CPPs obtain a status of the "must-to-run" generators at the capacity market with raised regulated capacity price. Forced operation of CPPs with large condensing electricity output increases prices in the wholesale capacity market.

To increase efficiency of the wholesale electricity and capacity market it is necessary to differentiate prices for electricity generated at CPPs in combine and condensing cycles. The wholesale market rules should be corrected to give CPPs permission to sell two kind of electricity produced in combine and condensing cycles. The existing procedure of fuel cost sharing between heat and electricity production at CPPs has to be improved.

4. Cross-subsidies in the electricity and capacity markets in Russia impose an additional financial burden on the industrial consumers. Cross-subsidization in the electricity sector is a mechanism where some consumers pay a higher price when compared with the cost of energy delivered to them. The additional revenue generated from them is redirected to cover the revenue shortfall from other consumers [19]). Cross-subsidization in Russia appeared during the economic reforms as an element of social protection.

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The issue of cross-subsidization is complex and non-transparent. Further, the real impact of cross-subsidies on the electricity prices is hard to define. However, this issue remains a challenge in the market and should be mentioned as a possible constraint for the market development and an additional cost to the industrial consumers [17].
There are several types of cross-subsidization in the Russian power industry. Among them [17, 20]:

4.1. Subsidizing of residential and social consumers.
At the electricity and capacity markets residential customers and several other groups of social consumers, paying low tariffs are subsidized by the industrial consumers, paying full cost of capacity and electricity with the addition of a subsidy. Agricultural consumers are also subsidized in some regions of the country.

Currently, all electricity consumed by residential (and social) consumers is subsidized. Regulated tariffs for these groups of customers are set by the regional regulating authorities. Amounts of subsidies for population are different in different regions. Subsidies for population significantly increase electricity prices for small and middle-size businesses in regions where are not located large industrial enterprises. This type of subsidies takes significant part of the total cross-subsidizing amount.

Mechanism of subsidizing is uniform for all levels of population. It means that residential customers with high incomes and consuming large amounts of electricity get more subsidies as compared with poor population. Often subsidizing of residential customers is realized through reduction of transmission tariffs for social consumers and rising transmission tariffs for other groups of customers.

4.2. Inter-territorial subsidizing.This type of cross-subsidization consists in artificial lowering prices for the wholesale consumers in some regions of the country at the expense of rising prices in others territories. At present, there are subsidies for territories of the Russian Far East, republic of Crimea, republics of North Caucasus, and Kaliningrad region. Part of costs for price lowering subsidizes the State budget. Another part is shared among subsidizing regions.

4.3. Cross-border trade subsidies.
Russia has both the capacity and electricity markets. Two markets create extra challenges in the cross-border trade arrangement. Russia is surrounded with Post-Soviet states and with Finland and Norway in the North-West (Fig. 1). The trade is organized in such a way that the importing countries do not pay for the capacity in Russia.

When defining the capacity demand for the capacity market, Russian System Operator (SO) reserves capacity for the export deliveries. But the cross-border trade is based on price made up in the electricity market.Therefore, the neighboring countries have double benefits: they buy electricity at prices of the Russian electricity market and enjoy reliability improvement for domestic consumers at the expense of consumers in Russia [20].

One way how the issue can be resolved is the adoption of more explicit cross-border price allocation. In such a case, Russian SO could reserve capacity in the capacity market with a glance of export demand and take into account the capacity cost in the cross-border trade. Another option under explicit cross-border price allocation is the case where a foreign country with an electricity-only market could participate in the Russian capacity market in order to receive capacity payments for reliability provision for domestic consumers.

4.4. Subsidizing of electricity generation at the expense of heat production.
This is the most widespread type of subsidizing used at cogeneration plants. Amount of subsidies reaches up to 30 % of fuel cost and related overheads required for the electricity generation [20]. This type of subsidizing also includes some cost redistributions, such as between basic, semi-basic and on-peak heat power and electricity.

Subsidizing of electricity consumers at the expense of the consumers receiving heat power also occurs in practice. This method of cross subsidizing is invisible and hidden from ordinary consumers. In the past there has been an opinion that heat power generation at the cogeneration plant is economically unprofitable and that the state is forced to provide donations for the production of heat at the expense of electricity which is more profitable. Indeed, this opinion is deeply wrong.

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Thorough analysis of the combined cycle expenses shows that each consumer using the heat power produced at cogeneration plant is a beneficial consumer [20]. It provides significant fuel saving not only for it but also for electricity consumers who do not use heat from the cogeneration plant. Residents receiving heat from the cogeneration plant provide low electricity prices not only for themselves but also for other residents of the region.

Unfortunately, up to the present there are no privileges for customers consuming simultaneously heat power and electricity from the cogeneration plants. Thus, the social consumers or city residents consuming electricity from a cogeneration plant often do not belong to the category in need of subsidies. On the contrary – they are "fuel saving donors" who subsidizes other consumers that do not use cogeneration plant heat power.

VII.CONCLUSION

1. During latest two decades Russia has undertaken wide range of efforts for electric power sector liberalization. The regional power companies were restructured. Forms of ownership were changed. The wholesale and retail electricity markets were launched. The State and sector legislation was renewed. Electric power sector ceased to be a restraining factor for national economy.

2. However, a set of challenges affecting the efficiency of competitive markets in Russia remains up to date. The most evident and significant problems are:

- Insufficient competition within retail electricity markets;
- Electricity and capacity market in Russia contain obsolete generation equipment;
- Existing legislation provides for ineffective participation of the combine cycle thermal power plant in the wholesale electricity and capacity markets;
- Cross-subsidies in the wholesale and retail markets impose an additional financial burden on the industrial consumers.

3. To eliminate the drawbacks of the electricity market organization it is necessary:

- to increase the number and functions of the independent supply companies;
- to remove the requirement for mandatory sale of electricity generated by the powerful plants only in the wholesale market. Local power plants should have opportunity to sale electricity both in the wholesale and retail markets;
- to differentiate prices for electricity generated at thermal power plants in combine and condensing cycles. Market rules should permit the thermal power plants to sell two kind of electricity produced in combine and condensing cycles;
- step-by-step reduce all kinds of cross subsidies in the nearest future.

4. The success of electric power sector reforms depends on the economic situation and urgent aims in each country. The liberalization experience and structural reorganization in the Russian power sector could be helpful for countries developing modern electricity market**s.**

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