TRANSORMATION OF ELECTRIC POWER INDUSTRY IN GERMANY

Olga Shuvalova

RUDN University
Department of the regional economy and geography
Miklukho-Maklaya str., 6, 117198, Moscow, Russian Federation
e-mail: dvigh@mail.ru

Abstract: *The mail purpose of the article is to study the German electricity market, which is actively developing. The study findings revealed that moreover 100 years the natural monopoly structure dominated the electricity market in Germany. Despite the expectations liberalization of electric power industry of the country has led to further monopolization of the sector. Problems encountered due to the liberalization were identified It was proved that the market competition mechanisms announced as the main goal of the liberalization of electricity sector started to work only at the stage of electricity generation. The diversification of suppliers, the significant reduction of the cost and wholesale energy price are taking place right here. in the article the current changes are characterized. The article notes that the goals of alternative energy development, set at the state level, required the restructuring of the entire energy system in Germany. Analysis of the current situation confirmed that companies change strategy and tactics of activity on the electric power market, adjusting to new realities. From one hand, the market activities are tightly controlled by the government. From the other hand, both private and public capital are struggling for investment-attractive sectors which are subsidized by the government. Simultaneously with the liberalization of the power market, the German government supported the development of alternative energy. Under condition of the so called "energy transition" we see that electricity market is divided between the largest players by the fields of economic activities. Vertically integrated companies get rid of large power plants, concentrating their activity on innovative directions of the power industry development. It's worth mentioning the renewable energy use as well as the network business, decentralized energy supply and power distribution. The situation in the electric power industry of Germany was studied both at the level of activity of large companies and at the level of work of municipalities. It is shown that it is difficult for them to retain their positions in the electric power market. At the same time, the greatest activity of public utilities is observed in the sphere of organization of decentralized energy supply.*

Key words: *Germany, liberalization, electricity market, energy state policy, organizational and spatial structure*

JEL codes: *R12, P18, L41*

1. Introduction

Germany has the most powerful power plant park in Europe and is after Russia the largest electricity producer. In 2017, the installed capacity of Germany's power plants was 207.9 GW. They generated about 655 billion kWh of electricity (www1). The history of Germany's electric power industry is more than 130 years old. Germany's power industry includes hundreds of high-capacity power plants of different types, hundreds of thousands of kilometres of transmission lines (LEPs) and more than 25 thousand km of heat distribution networks.

Energy Regulation is mainly subject to the Energy Industry Act. In Germany the first Act was issued in 1935 and was valid until 1998. The purpose of the Energy Industry Act was to ensure a stable, uninterrupted supply of electricity to the consumer. The act fixed the natural monopoly structure that dominated the electricity market in Germany.

In 1998 and 2005 Germany adopted new Energy Industry Acts. A new stage in the development of the electric power industry in Germany began. Germany joined the EU-announced program to liberalize the markets for grid energy (the EU Directive on the liberalization of the electricity and gas markets in 1996 and 2003).

The goal of liberalization was the intensification of competitive relations in electricity market which should lead to the reduction of the electricity price for the end user due the reduction of electricity generation costs. Liberalization has really provided free access to networks – to the natural monopoly of energy companies but did not lead to a significant reduction in prices for the end user as it was envisaged by liberalization (Shuvalova, 2009).

The German power market is actively developing. The retailing prices have not been reduced, but the structure of costs in the price of electricity for the end user has changed significantly. So, thanks to the state support of energy production based on alternative sources and the growing role of solar, wind and biomass energy in energy production, there was a surplus of electricity on the market. According to this the electricity prices on the wholesale exchange have decreased significantly. At current time, in the structure of the retiling price the cost of purchasing electricity at power plants is small. The end user in Germany pays a large Renewable Energy surcharge and grid fee, which are included in the retailing price of electricity. And due to this, it is one of the largest in Europe.

The powerful state financial support of alternative energy production in Germany and the development of network infrastructure led to the changes in business activities of vertically integrated companies on the power market in Germany. So, German vertically-integrated companies began to work in those sectors that until recently were not attractive to them, for example, in the field of alternative energy. At the same time, vertically integrated companies are refusing from the production of electricity at large power plants. The role of public utilities in the power market in Germany is also changing. Due to lack of financial resources, they are forced to cooperate with private business.

The purpose of the article is to characterize the changes in organizational structure of power generation (analyzing main electric power producers), of long distance power transmission, of regional energy distribution (analyzing main regional and local system operators), of electricity retail.

Russia is still a major supplier of energy in Germany. In order to understand the future role of Russia in the energy market in Germany it is useful to know what is happening in Germany. Understanding the experience of transformational process in the energy sector in Germany will allow to avoid mistakes by the implementing of the energy strategy in Russia. It will affect the further possibility of supply with energy sources from Russia to Germany (Rodionova et al., 2017).

2. Methodology and Data

The article is devoted to the development of the spatial and organizational structure of the electric power market in Germany. We have studied the activities of major energy producers, of major transmission and distribution system operators as well as major communal companies (so called «Stadtwerke») on the market.

We have studied how these companies change their strategy and tactics on power market. We have studied, which assets are non-performing assets and why the companies get rid of those assets and how the companies are opening new possibilities for their activity adjusting to new realities.

In our scientific research we have used annual financial reports of German power companies including annual financial reports of E.On, RWE, Vattenfall and EnBW, as well as reports of another companies – Transmission and Distribution System Operators and utility companies so-called «Stadtwerke».The analysis was carried out on the basis of the annual reports of the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (so called Bundesnetzagentur) about development of power industry in Germany too.

Much attention was paid to the study of the structure of the price of electricity for the end user and of the cross-country electricity price comparison on the wholesale European Energy Exchange.

For the authors of this article, measures of state support for electricity generation based on alternative sources and the development of network business in Germany are of great interest. The study examined the legislative framework including Energy Industry Acts, Renewable Energy Ect, as well as Power Grid Expansion Act (Gesetz zum Ausbau von Energieleitungen) and Federal Requirement Plan for Electricity Transmission Networks (Gesetz ueber Bundesbedarfsplan).

On the basis of available sources, maps of supply areas of the companies on the electricity market in Germany were built.

The cartographic method evolved to illustrate the changes that took place in the German electricity market - the monopolization of Germany's power industry (at the first stage of liberalization) and the separation of a network operators from other business of vertically integrated companies (in the second stage of liberalization).

The analysis carried out by the author makes it possible to identify problems and changes in the power industry in Germany.

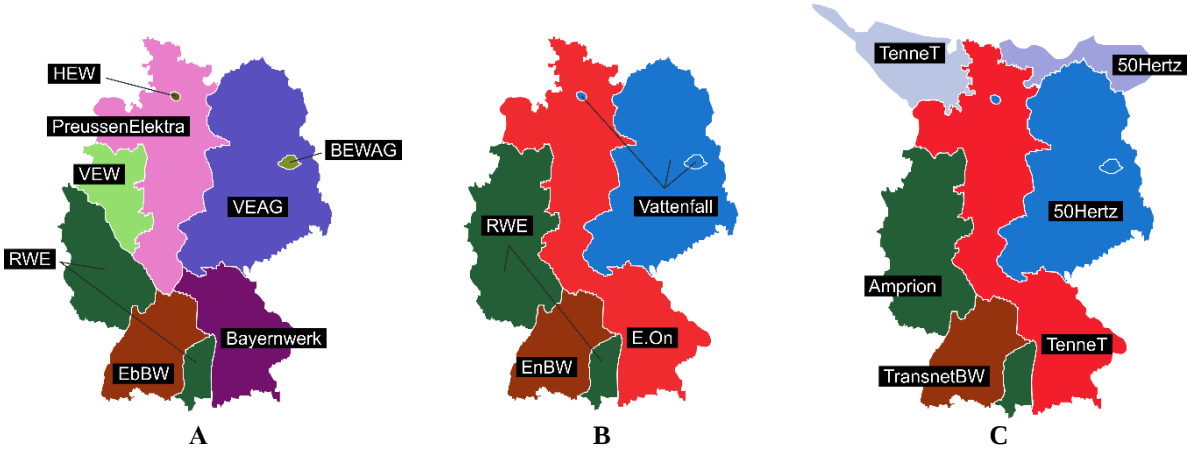
3. Results and Discussion

3.1. Changes in organizational structure of power generation – the refusal of vertically integrated companies to produce electricity at large power plants in favor of increasing electricity production based on the use of alternative energy sources

At the beginning of the 21st century electricity production of the Federal Republic of Germany was accumulated by the four largest vertically-integrated companies «E.On», «RWE», «Vattenfall» and «EnBW». They controlled all electricity supply chain – from its generation to its end-user delivery.

Liberalization of electric power sector has strengthened positions of electricity monopolies (fig. 1). At the turn of the millennium, companies «RWE» and «VEW» merged to form «RWE». «Bayernwerk» and «PreußenElektra» were merged to create «E.ON Energie». In 2003 companies BEWAG», «HEW» and «VEAG» were merged to form «Vattenfall», headed by a Swedish company, and created a new player on the electricity market of Germany. «EnBW» was formed from the merger of two utilities companies «EVS» and «Badenwerk» in 1997 was bought in 2000 by a company «Electricite de France», owned by the French state.

Fig. 1 Respective supply areas of the companies on the electricity market in Germany in 1999 (A), in 2007 (B), in 2018 (C)



Source: Own study.

Nowadays the situation has recently changed. The power market is represented by many independent energy suppliers that are owners of many renewable energy power plants. The price of electricity on the wholesale market has significantly decreased due to excess supply (Mayer et al., 2018). All electricity output that will be generated within coming years on the power plants owned by the largest vertically-integrated companies is already sold out.

3.2. State support of innovative activities in the power industry, change in the structure of electricity retail prices as key factors of changes in business activities of vertically integrated companies

The electricity price on the «European Energy Exchange» – «EEX» in Leipzig is constantly falling. In 2015 an average electricity distribution spot price was only 31.61 EURO/MWh (while end-user electricity price was 29.51 cents per kWh, and 19.79 cents for industrial customers) (www2). In other words, end-users pay the price 7-10 times higher from a purchasing electricity price provided by electricity producers on the energy exchange.

Taxes (including renewable energy surcharge) and fees (including grid fees) account for roughly half of the electricity price for end-consumer. In Europe the share of taxes and fees included in a retail price is much lower as in Germany and accounts about 33%. The significant part of a price for end-users completes the grid fee called «Netzentgelte». In 2015 the grid fees for households accounted 6.71 cents per kWh, that is a quarter of the electricity price (www2).

We will discuss grid fees later. If we talk about the Renewable Energy surcharge so-called EEG-Umlage it was introduced in 1999 due Renewable Energy Sources Act (Erneuerbare Energien Gesetz – EEG) previously Act on granting priority to Renewable Energy Sources. The tax is levied on activities which are considered to be harmful to the environment and is intended to promote environmentally friendly activities. The tax is levied on all manufactures except the renewable energy production as well as the production of heat and energy at a relatively clean combined steam and gas turbine machinery.

Formally, this tax must be paid by electricity producers – owners of power plants. But they do not pay anything themselves. This tax is included in the retailing electricity price for the end user. And calculations, how

much will be the annual tax EEG-Umlage, is maintained by the network operator depending on the current generation of electricity based on alternative sources and appropriate compensation payments. Where are they spent?

According the law every kilowatt-hour generated from a renewable electricity facility receives a confirmed technology-specific feed-in tariff for 20 years. Grid operators are required to preferentially dispatch this electricity over electricity from conventional sources.

The EEG contains targets for increase of the share of renewable energy in electricity production. The indicators introduced into the law are adjusted in accordance with the requirements of the current situation. So, the law was revised already 4 times – in 2004, 2009, 2012 and 2017. For example, in 2009 the subsidy period for the owner of the renewable energy power plant was limited to 20 years of operation. This stimulates the development of technology and increases the profitability of renewable energy production. The list of alternative energy sources that are used in the electricity generation and that are subsidized, is also changed. In 2017 it became clear that the power system is not ready to accept additional volumes of electricity. Therefore, the Government of Germany was forced to limit the measures of state support to the producers of "green" energy. The programs for supporting the construction of wind power parks in coastal zones are being maintained. However, the volume of their construction is strictly regulated. If on a stormy day the power lines are too congested to deliver wind power, grid operators can order renewable power producers to disconnect from the network. But compensation must be paid. Competitions for the construction of new renewable energy power plants will be carried out on a new principle, which stimulates an increase in the profitability of energy production.

Such cost allocation in the end-user electricity price structure has led to the market restructuring – to the assets reallocation in favour of the attractive sectors – the development of the renewable energy as well as the development of the network business, creation of decentralized energy supply and distribution and its retailing (Knaut et al., 2016). At present, vertically integrated companies get rid of large power plants, concentrating their activity on innovative directions of the electric power sector development.

The fact that the German vertically-integrated companies go out of generation activity proves the following example. One of the modern and well-equipped lignite-fired power plants of Germany «Schwarze Pumpe» built in 1997 was purchased by a Czech consortium «Energetický a průmyslový holding» – «EPH» and its financial partner PPF Investments Ltd. in 2016. Along with the power plant «Schwarze Pumpe» company «Vattenfall» also sold power plants «Jänschwalde» и «Boxberg» and a 50 percent stake at the plant «Lippendorf» (earlier it shared ownership with «EnBW»).

Many of the coal and nuclear power plants in Germany are closing due to its inefficiency. In 2015 large electricity producers «RWE», «Vattenfall», «MIBRAG» (which develop coal mining and operate power plants) and a Federal Government signed an agreement stating that from 2016 to 2019 the most coal power plants with a total capacity of 2.7 gigawatts of power output will close down in the Rhenish lignite-mining region and the Eastern Germany. Within next 4 years these power plants will be used as reserve capacities and they will be able to generate power in case of current energy lack. The operators will be compensated for an early decommissioning of their power plants.

3.3. Ownership structure in power generation – exchange of assets between vertically integrated companies

Let us to characterize the ownership structure in power generation. Besides the four vertically integrated companies «E.On», «RWE» and «Vattenfall» there are other large electricity producers in Germany such as «EWE AG», «RheinEnergie AG», «MVV Energie AG», «N-Energie AG», «Pfalzwerke AG», «Stadtwerke Muenchen GmbH», «Stadtwerke Hannover» (www3).

It is important to note that in 2016 almost 30% of all energy in Germany was generated by alternative energy plants (www4). Most of them are small plants owned by small business, private landlords and households. There are a lot of such small plants in Germany and it is not possible to analyze all of them in this study.

Company «E.On» – is an international company (with its headquarters in Essen), who's shares belonged to investors from Germany (35%), USA and Canada (23%), Great Britain (16%), France (10%) and others in 2017. In recent years we see an active equity swap between the main companies on the international electricity market. «E.On» shares are also traded worldwide. The major part of its business is also related with foreign assets.

In 2016 the management of the company «E.On» went to the radical transformation of business and merged all large power plants (except nuclear ones) to one separate company «Uniper», whose shares are traded internationally. In 2018 the Finnish state power company «Fortum» bought 46.65% stake in «Uniper». Moreover, a significant part of «Uniper» shares belongs to international investment holdings. Three of them are based in New York. These are the companies: «Elliott Management Corporation» (holds a 7% stake in «Uniper»), «Knight Vinke Asset Management» (5%) and «BlackRock» (4%).

Nowadays the company «E.On» operates renewable power plants, network infrastructure and retailing divisions. «E.On» nuclear power plants are still operated by its subsidiary company «PreussenElektra». It is known that the lifetime of a nuclear power plant is legally limited in Germany and construction of new plants is not allowed. Thus, «E.On» will eventually generate only renewable energy.

«E.On» management is ready to sell its nuclear plants but the Federal Government of Germany did not approve this operation considering it to be dangerous to transfer nuclear plants to unknown buyers.

In 2018 the «E.On» management agreed with «RWE» shareholders on assets swap and decided to purchase most assets of «Innogy» («RWE» subsidiary company). In fact «E.On» was able to consolidate assets of the two leading energy companies related to renewables development and their network business. Companies «E.On» and «RWE» allocated roles between each other. «E.On» will continue to do business related to renewable energy development and other innovative projects and «RWE» will operate power plants.

Company «RWE» is an international company (based in Essen), which shares are traded on stock exchanges in Frankfurt am Main, Dusseldorf, Berlin, Hamburg, Hannover, Munich, Stuttgart and in foreign countries of Europe and USA. In 2017 among legal entities holding shares of the company (institutional investors) 29% were registered in Germany, 22% – in USA and Canada, 18% – in Great Britain and Ireland. The location of some «RWE» shareholders and investors can not be identified.

The major «RWE» shareholder is «RW Holding Aktiengesellschaft», established in 1992 by local and municipal authorities to participate in «RWE» activity. Moreover another «KEB Holding», established in 1975 by the city authorities of Dortmund and other regions, holds «RWE» shares. In 2017 «RW Holding Aktiengesellschaft» and «KEB Holding AG» together held a 15% stake in «RWE».

The participation of an American investment company «BlackRock» (founded in 1988 in New York) in a business activity of «RWE» is also interesting. It holds 5% of shares in «RWE». As it was mentioned before «BlackRock» holds at the same time shares of other electricity company «E.On».

In 2016 «RWE» separated its subsidiary into a company «Innogy», involved in renewable energy. In 2018 it was sold to «E.On». In return, «RWE» got a 17% stake in «E.On» – in assets related to renewable energy. Thus, nowadays «RWE» is one of the leading energy producers in Germany.

«Vattenfall» (based in Berlin) is wholly owned by the Sweden Government and operates on the East German electricity market.

A company «Vereinigte Energiewerke AG» – VEAG was founded after the German reunification in 1990; large East German electric utilities companies like «Bayernwerk», «Preussen-Elektra» and «Rheinisch-Westfälische Elektrizitäts-Werke AG» (RWE) became its major shareholders. In 2002 a Swedish government enterprise «Vattenfall» purchased «VEAG».

It is worth mentioning about the company «EnBW». It was established by the state of Germany – Baden-Wurttemberg and its municipal authorities. In 2000 the state authorities had to sell a 45.01% stake to the French government enterprise «EdF». However in 2010 the authorities of Baden-Wurttemberg managed to return ownership and to redeem shares of «EnBW».

German companies operate both on local and international markets. More and more ambitious projects on wind farm parks construction and electricity exchange between the countries are implemented (Hawker et al., 2017). German companies succeeded in many innovative electricity projects in the basins of the North and Baltic seas. Particularly in the Baltic Sea Germany in cooperation with other countries realizes concept of creating the Baltic ring. It will involve most regions of the North-West of Russia. The Baltic ring will contribute to exchange of energy from wind farms.

Construction of large wind farm parks in a modern Germany is a prerogative of vertically-integrated companies. For instance, one of the largest wind farm of Germany «Nordsee Ost» with a capacity of 295 MW, located in the North Sea, belongs to «Innogy». Another wind farm «Amrumbank West» is located nearby and belongs to «E.On». 51% stake of a wind farm «DanTysk» belongs to «Vattenfall», 49% - to the communal company «Stadtwerke München». «EnBW» built one of the most powerful wind farms «EnBW Baltic 2» in the Baltic Sea.

3.4. Changes in organizational structure of long distance energy transmission – the separation of network operators from other business of vertically integrated companies and sale of newly founded independent Transmission System Operators to foreign companies

In Germany transmission of energy from power plants to end users was carried out by companies of “different levels”, classified by distance of transmission and voltage of the operated networks. Within a country electricity was distributed by companies of federal level, within regions – by companies of regional level (formally so-called regional network operators – «Uebertragungsnetzbetreiber»), delivery to end-users and retailing was carried out by utility companies called «Stadtwerke», founded by municipal authorities. But the situation is significantly changed. It was caused due to the next happenings. The electricity market entered new independent

energy suppliers, owners of renewable energy power plants. The government launched a program of expanding the capacity of networks.

In 2009 Germany adopted Power Grid Expansion Act (Gesetz zum Ausbau von Energieleitungen). By this law, until 2030, 1800 km of high-voltage transmission lines must be built in Germany.

In 2009 Germany adopted an additional law – Federal Requirement Plan for Electricity Transmission Networks (Gesetz ueber Bundesbedarfsplan). In accordance with the last law, the state will allocate money for the construction of another 6,100 km of power transmission lines.

The liberalization in fact does not lead to a competitive relationship in electricity market.

At the first stage of liberalization companies started to unite for reducing costs. After concentration on a federal level companies «E.On», «RWE», «Vattenfall» and «EnBW» significantly expanded their influence on other stages of energy redistribution. The number of supplying companies is halved and there are no companies on the regional level that are independent from the federal ones. Due to a budget gap local authorities also lost impact on the electricity companies and were forced to sell their shares in utility companies «Stadtwerke».

On the second stage of liberalisation – so called "energy transition" long distance electricity transmission sector has changed. Electricity producers «E.On», «RWE», «Vattenfall» and «EnBW» legally have no right to own high-voltage power lines. Nowadays in Germany most companies so called «Uebertragungsnetzbetreiber» (Transmission System Operators) provide long distance energy transmission as independent companies. It is interesting, that foreign capital and large financial investment companies also play an important role here, similar to the generation sector. At present many high-voltage power lines in Germany are operated by companies with a predominance of foreign capital.

3.5. Changes in organizational structure of energy distribution within regions – the strengthening the position of vertically integrated companies in the network business of Distribution System Operators, cooperation with municipal authorities during the revision of concession contracts

Under the new energy act Distribution System Operators (formally so-called regional network operators – «Verteilnetzbetreiber») must be independent from the companies that are selling electricity. However, they are still owned by municipal authorities or vertically integrated companies – companies that are selling electricity.

Nowadays Distribution system operators have a new task. They are responsible for a fast grid connection of new renewable energy generators. One of the main functions of DSO has become they the performance of uninterrupted power supply of end-users and support of relevant grid capacity reserves for renewable power plants required in peak hours. Expenses arising during these operations are compensated by the state through grid fees (so called «Netzentgelte») included in a retail price. As it was mentioned before grid fees accounts for about one fourth of the price.

Historically municipal authorities could significantly impact the operation of electricity companies because the municipal authorities own lands along the roads, in cities, towns and urban areas. Power lines are being installed on these territories. For construction and operation of power lines the companies must conclude with municipal authorities the concession agreement. But due to funding lack the local authorities were losing control over utility companies so-called «Stadtwerke» and vertically integrated companies became owner of them. The validity period of many concession agreements expired in 2015-2016. Their renegotiation was an important milestone in the history of power industry in Germany. Thereby the municipal authorities hoped to return ownership of distribution utilities. However, as it was mentioned before, they lack funding for such return and for further operation of these networks. Only in some cases vertically integrated companies shared their assets with municipalities, but in general they agreed on joint ownership in electricity network business.

Distribution System Operators mainly belongs to large energy producers of the country – to vertically integrated companies – E.On, RWE, EnBW and Vattenfall. 8 out of 10 largest regional system operators are owned by the above mentioned vertically integrated companies. The impact of «Vattenfall», operating on the territory of the East Germany, on Distribution system operators business is limited. At present, it owns only one company «Stromnetz Berlin GmbH» which provides citizens of Berlin with electricity and heat. The root of the situation can be found in the events related to the reunification of Germany when the control over the new electricity markets was obtained by the West German companies. They retain their influence at the electricity distribution level in East Germany. But it's worth mentioning exceptions. In East Germany are located such independent companies as «TEN Thueringer Energienetze GmbH» and «ENSO». They became public utility companies are owned by municipal authorities. It means that some East German companies are available to control energy supply system with its own efforts and at own expense.

3.6. Changes in organizational structure of electricity retailing to the end-user – the monopoly of vertically integrated companies by the end user electricity supply and the leadership of municipalities in the decentralized energy supply and the use of innovative solutions

Vertically integrated companies in Germany have expanded their influence on energy retailing sector despite the fact that nowadays according to law any energy consumer either a private household or a large industrial plant can choose an energy supplier from thousands of companies operating in the country.

Vertically integrated companies have more leverage (first financial) than other companies, firstly – municipal authorities. They can offer more attractive prices. And as it was mentioned before vertically integrated companies control operations of many utility companies.

According to the Federal network agency «Bundesnetzagentur», companies «E.On», «RWE», «Vattenfall» and «EnBW» controlled 69% of the energy retailing market through subsidiaries and joint ventures with local authorities in 2015 (www2). For comparison: in 2002 vertically integrated companies controlled 76% of energy generation, a significant part of transmission and only 29% of retailing (Shuvalova, 2008).

Nevertheless, municipalities take active part in creation of decentralized power supply systems – in systems when a small region provides itself with energy. It becomes possible through generation in small energy plants using widespread renewable sources, through using battery and also through energy supply and demand management. Nowadays measuring equipment is necessary to measure and to record real time energy consumption, i.e. network load. That is why it has become so popular in Germany and all large energy consumers are already equipped with watt-hour meters (Bertsch et al., 2016).

4. Conclusions

Energy policy in Germany is a perfect field for a scientific research. Liberalization of electric power industry of the country has led to further monopolization of the sector. This process includes state support program for independent renewable energy production, for network transmission capacity extension and for uninterrupted energy supply. This state program was named “energy transition”. Its realization would have been impossible without increasing taxes in the energy retail price structure.

Those activities of energy companies that received good financial support from the government became more investment-attractive. The better state financial support of several energy economy fields contributed to capital outflow from generation sector to end-user supply, retailing sector and services.

It is worth keeping in mind that energy policy in developed countries (including Germany) in the field of renewable energy is caused by local energy resources lack. The government of developed countries is intent on decrease of import reliance and on increase of energy security of the country. The goal to protect the environment is set but is not decisive.

The electric power market of Germany is actively developing and there is still much to do. Earlier on the electricity market of Germany we noted a division of the country between the largest electricity companies by their respective supply areas. Nowadays under condition of the so called “energy transition” we see that electricity market is divided between the largest players by the fields of economic activities.

As a result, the market competition mechanisms announced as the main goal of the liberalization of electricity sector started to work only at the stage of electricity generation (Graf et al., 2013). The diversification of suppliers, the significant reduction of the cost and wholesale energy price are taking place right here. Electricity generation in Germany is characterized by over-generation and many economists have doubts about the efficiency of the state energy policy. Operating in this sector is steadily becoming unprofitable not only for large producers but also for independent suppliers of electricity generated from the alternative sources (Liebau et al., 2011). After new producers entered the market, government had to reconsider its network business policy and to support new infrastructure projects.

International financial investment enterprises are more and more active on the German electricity market. At the same time German companies also actively operate abroad. The European countries realize large international projects, including new infrastructure building in the electricity sector.

The experience of Germany’s so-called “energy transition” should be used by pursue of the energy policy in Russia and other countries.

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References

Bertsch J., Growitsch C., Lorenczik S., Nagl S. (2016): *Flexibility in Europe’s power sector — An additional requirement or an automatic complement?* “Energy Economics”, Vol. 53, pp. 118-131.

doi:10.1016/j.eneco.2014.10.022

Graf C., Wozabal D. (2013): *Measuring competitiveness of the EPEX spot market for electricity*. "Energy Policy", Vol. 62, pp. 948-958. doi:10.1016/j.enpol.2013.07.052

Hawker G., Bell K., Gill S. (2017): *Electricity security in the European Union – The conflict between national Capacity Mechanisms and the Single Market.* "Energy Research & Social Science", Vol. 24, pp. 51-58. doi:10.1016/j.erss.2016.12.009

Knaut A., Tode C., Lindenberger D., Malischek R., Paulus S., Wagner J. (2016): *The reference forecast of the German energy transition – An outlook on electricity markets.* "Energy Policy", Vol. 92, pp. 477-491. doi:10.1016/j.enpol.2016.02.010

Liebau B., Ströbele W.J. (2011): *The shortcomings of the architecture of the German electricity market.* "The Electricity Journal", Vol. 24(5), pp. 21-28. doi:10.1016/j.tej.2011.05.014

Mayer K., Trück S. (2018): *Electricity markets around the world*. "Journal of Commodity Markets", Vol. 9, pp. 77-100. doi:10.1016/j.jcomm.2018.02.001

Rodionova I.A., Shuvalova O.V., Sakharchuk N.S. (2017): *The impact of globalization on the development of alternative energy in Russia.* In Kliestik T. (ed.): *Globalization and its socio-economic consequences. 17th International Scientific Conference Proceedings*. University of Zilina, Zilina, pp. 2191-2198.

Shuvalova O.V. (2008): *Changes in territorial organization of energy in Germany since mid of the 20th century.* PhD thesis in Geography (in Russian).

Shuvalova O.V. (2009): *Expansion of the monopoly of electric power companies in Germany's energy markets.* "Issues of Economic and Political Geography of Foreign Countries", Vol. 18, pp. 111-127 (in Russian).

Online sources

(www1) http://www.ag-energiebilanzen.de/

(www2) https://www.bundesnetzagentur.de/

(www3) http://www.verivox.de/

(www4) http://www.bp.com/