

## LIBERALIZATION OF ELECTRICITY MARKET IN GERMANY

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### Abstract

The main object of the research is to examine the degree of electricity market liberalization in Germany which is influenced by the dominance of vertically integrated companies. It is impossible to increase the number of new electricity suppliers generated from renewable sources, due to the limited capabilities of the transmission network.

This article evaluates the results of two energy policy directions of German government. The first direction is the implementation of renewable energy support policy; the second is the liberalization of the electricity market. These tasks are interrelated.

The authors were analyzed the structures of the electricity market of Germany. In the research was analyzing the ownership structure in the electricity market: electricity generation, transmission, distribution and supply of electricity to end-users.

The analysis of the research showed that, on the one hand, the electricity market liberalization as a regulation of natural monopolies for the creation of a competitive environment wouldn't be possible in Germany without the support for alternative energy and the entering the market of new electricity suppliers. On the other hand, the renewable energy growth would be impossible without the electricity market liberalization which allowed the common access to the private electricity network.

**Keywords:** energy policy, electricity market, energy transition, Germany, liberalization, renewable energy

## 1 INTRODUCTION

The authors find the information for this research in the reports of "Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway" - "Bundesnetzagentur" [3], "German Association of Energy and Water Industries" - "Bundesverband der Energie und und Wasserwirtschaft" - "BDEW" [1] and "German Association of Local Utilities" "Verband kommunaler Unternehmen eV" - "VKU" [12]. In the analyzed data set, the ownership structure in the electricity market was studied in accordance with the information posted on their official websites.

Some aspects of the liberalization of the electricity market in Germany have been investigated by studying the scientific works of German scientists.

In particular, Sönke H. writes about required legal norms that will encourage both producers and consumers of electricity to improve the efficiency of the energy system. By the increase of the renewable electricity generation it becomes more difficult to achieve balance of supply and demand in the energy system. The electricity cannot be stored in large quantities and you need to generate as much electricity as everyone consume at the moment [10].

Mayer J. and Burger B. [8] writes that the electricity produced from alternative energy sources is increasingly being traded in the spot market. However, electricity prices in the spot market are minimal and often don't even cover the manufacturer's costs. To ensure the profitability of renewable energy production the state need to raise the renewable energy sur-charge – so called “EEG-Umlage” included in the price for retail consumers. The authors of this research believe that it is necessary to reverse this trend and do not allowing excessive supply on the market. It is necessary to resort to such regulatory measures, since renewable electricity generation is unprofitable without state support.

Pavel F., Cullmann A., Girard Y. and Nieswand M. [9] state that in Germany the profits of the independent network operators, separated from the vertically integrated companies, in the 21st century did not change significantly. This means that in the network business - the former natural monopoly - is competitive and none of the network operators takes its advantages on the market in their region.

Jenner S., Schmitz-Grethlein F. and Uhlemann A. [6] talk about the extensive opportunities for the communal enterprises - the so-called "Stadtwerke" - in the electricity market. They can significantly expand presence at the region market. The advantage of the communal enterprises is that they can renew or terminate the concessions linked to operation of power transmission lines and closest located to final consumer.

The activities of communal enterprises are also the goal of the study of Kurt B. and Wagner O. [7]. The authors note that in the 90 years of the 20th century we observed mass privatization of communal enterprises. It was facilitated by the liberalization of the electricity market, which led at the first stage to strengthening the degree of the market monopolization by vertically integrated companies. However, many communal enterprises - the so-called "Stadtwerke" – survived that ordeal. Now there is a so-called “re-municipalisation” of the Germany energy sector, when vertically integrated companies sell their stakes in Stadtwerke to consolidate their efforts in other different areas. Thus, communal enterprises face ambitious tasks – the tasks of increasing the energy efficiency in the energy sector, stimulating combined production of heat and electricity, developing renewable energy projects, expanding the wide range of services, etc.

## **2 SOURCES AND METHODS**

The history of the development of the territorial and organizational structure of the electric power market of Germany is described in the article. We have studied the activities of the major energy producers, of the major transmission and distribution systems as well as the major communal companies (so called "Stadtwerke") on the energy market.

The authors surveyed and presented the results of how these companies change their strategy and tactics in the electricity market.

In this scientific article authors used the annual financial reports of E.On, RWE, Vattenfall and EnBW, as well as reports of other companies - the so-called "Stadtwerke".The analysis was carried out on the basis of the annual reports of the Federal Network Agency for Electricity, Gas, Telecommunications, the Post and the Railway (so called Bundesnetzagentur).

Much attention was paid to the research of the structure of the price of electricity for the end user and the formation of a price on the European wholesale exchange of electricity European Energy Exchange. Also measures of the state support of electricity generation in Germany on the basis of alternative sources and development of network business were studied. The research examined the provisions of regulatory acts (Energy Industry Act, Renewable Energy Act, as well as Gesetz zum Ausbau von Energieleitungen and Gesetz ueber Bundesbedarfsplan). The analysis made it possible to illustrate the changes that have taken place. It was the monopolization of the grid electric power industry in Germany (at the first stage of liberalization) and the separation of the network component from the business of vertically integrated companies (in the second stage of liberalization).

## **3 NEW ELECTRICITY MARKET STRUCTURE IN GERMANY**

The energy policy pursued by the German government led to significantly change in the fuel balance of electricity power stations. The electricity generation in coal-fired and nuclear power plants was significantly reduced from 84% (in 1990) to 53% (in 2016) of total electricity generation. The renewable electricity

generation increased significantly in the same years from 4% to 29% (See Table 1).

**Table 1. The change in the fuel balance of electricity power stations in Germany (Calculated on the basis of electricity generation in power plants using various energy sources)**

Energy source	Electricity generation in 1990, TWh	The share, %	Electricity generation in 2016, TWh	The share, %
Natural gas	35,9	7%	81,3	13%
Coal	140,8	26%	112,2	17%
Lignite	170,9	31%	149,5	23%
Nuclear energy	152,5	28%	84,6	13%
Petroleum products	10,8	2%	5,8	1%
Renewable energy sources	19,7	4%	188,3	29%
Other energy sources	19,3	4%	27,3	4%
<b>Total</b>	<b>549,9</b>	<b>100%</b>	<b>649</b>	<b>100%</b>

Source: calculated by [5]

The ownership structure of the German electricity market has changed last years. It is necessary to investigate electricity market structure. Before the electricity were produced at large power plants that use fossil fuels (coal, oil, gas) for its generation.

The peoples used transmission lines to carry high voltage electricity over long distance (across the country). Then the electricity got the consumer through distribution network.

Now the electricity is generated on a wide range of renewable energy power plants. This electricity has a lower power. Such plants are connected to the network via low-voltage power lines. Often there are situations when the final consumer, being the owner of power plants using alternative energy, is both a consumer and an electricity supplier. Thus, not only large power plants supply the consumer with electricity, but the consumer themselves can supply the electricity in the opposite direction to the network.

In Germany, the network was operated by the companies of "different levels". They differ in the range of electricity transmission and in the voltage in the networks. Electricity suppliers of the federal level used the transmission networks to distribute electricity throughout the country, and regional providers – within the region. The electricity was delivered to consumers by communal enterprises created with the participation of municipalities - the so-called "Stadtwerke". The consumers purchase the electricity from them. However, due to the liberalization of the electricity market, the situation has changed significantly.

According to law the large electricity producers (vertically-integrated companies) couldn't own the networks (natural monopoly) in the case of long-distance electricity transmission, and the electricity supplies of final consumers could not own the networks provided within the region. There appeared a Transmission System Operator (TSO) and a Distribution System Operator (DSO). They must operate the power transmission lines and provide electricity through them. Transmission System Operator (TSO) is a system operator independent of electricity producers, who operate high voltage transmission lines and distribute electricity throughout the country. Distribution System Operator (DSO) is a large independent of the companies that sell electricity, system operators who operate of medium and low voltage transmission lines and distribute electricity in their region.

Regardless of who owns the network, responsible system operator must provide electricity, delivered by or to any company, through own power transmission lines. The transmission operators are supposed to charge for these services. The size of the fees is determined by law. The transmission operators also guarantee the uninterrupted supply of electricity to the consumer in their region.

According priority dispatch the network operators must feed energy produced by renewables into the grid. The companies developing renewable energy projects do receive other state benefits, as well as subsidies.

In 1999 year German government introduced ecological taxation. The tax was levied on activities which are considered to be harmful to the environment and is intended to promote environmentally friendly activities. The tax was 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. In 2000 year, the "Renewable Energy Sources Act" ("Erneuerbare Energien Gesetz"), previously "Act on granting priority to

renewable energy sources”) came into force in Germany. The EEG contains targets for increase of the share of renewable energy in electricity production. 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 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 year, 2009 year, 2012 year and 2017 year. For example, in 2009 year 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 year 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.

German system operators are making huge efforts to expand the network capacity in the changed conditions. These projects are subsidized by the state. In 2009 year, the "Power Grid Expansion Act" ("Gesetz zum Ausbau von Energieleitungen" – "EnLAG") was adopted, according to which 1800 km of high voltage transmission lines should be built in Germany until 2030 year. In 2013 year, the "Federal Requirement Plan Act" ("Gesetz über den Bundesbedarfsplan") is additionally adopted. In accordance with the latest law, another 6,100 km of power transmission lines will be built at the expense of the state. However, it is increasingly difficult to keep up with the increase in the total capacity of renewable energy power plants.

It should be noted that the target of the renewable energy support policy was to reduce the harmful impact of energy enterprises on the environment. However, recently we observe the increase in electricity generation at more "dirty energy facilities" – for example, in coal-fired power plants this is due to the specific use of alternative energy. The alternative energy sources are not permanent. The action of alternative energy sources is not constant. Therefore, at any time it is necessary to have reserve capacities of power to compensate for the shortage of electric power in the power system. Such reserve power plants in Germany are precisely the old coal-fired power plants [2].

#### 4 NEW DIRECTIONS OF VERTICALLY INTEGRATED COMPANY ACTIVITIES IN THE ELECTRIC POWER INDUSTRY IN GERMANY

In Germany the liberalization of the electricity market and implementation of renewable energy support policy caused the growth of total number market participants. These are large and small electricity generation companies, system operators, retailers, electricity supplies to the final consumers, large and small consumers etc. (See Table 2).

**Table 2. Electricity market participants in Germany in 2017 year**

Type of participant	The number
Electricity producers owning power plants with a total capacity of more than 100 MW	80
Network operators	905
Retailers and brokers providing intermediary services in electricity trading	130
Electricity supplies to the final consumers	1260
TOTAL	2375

Source: calculated by [1]

The electricity market is extremely complex ownership structure and it changes constantly. But the main players controlling the rest of the players are known.

These are E.On, headquartered in Bayreuth and RWE, headquartered in Essen. To the vertically integrated companies are rated Vattenfall, headquartered in Berlin and EnBW, headquartered in Karlsruhe too. In 2012

year, they generated 73% of the electricity supplied to the unified electric power system.

The same companies control other levels of electric power economy- the distribution and sale of electricity. According to the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway ("Bundesnetzagentur"), these companies in 2015 year through subsidiaries and joint ventures with local authorities controlled 69.2% of the electricity market [3].

However, vertically integrated companies were forced to separate the potentially competitive functions of generation and retail from the natural monopoly functions of transmission and distribution so that one of these functions was carried out by a separate company. The network business was bought by large financial and investment companies.

In Germany, high-voltage transmission lines are operated by companies with a predominance of foreign capital. Thus, the Transmission System Operator "50 Hertz Transmission", parted from the Swedish company "Vattenfall", is owned by the Belgian and Australian companies. Another Transmission System Operator "TenNet", a company that was separated from "E.On" business, was acquired by the Dutch Ministry of Finance. The subsidiary "Amprion", which operates high-voltage power lines, is not completely separate from "RWE", but the majority of "Amprion's" shares were bought by the German financial and investment group "Commerzbank". "EnBW" has carried out the network business by a separate company "TransnetBW", but it is still yet is owner of "TransnetBW". Moreover, EnBW does not belong to private capital, but to the regional and municipal authorities of Baden-Württemberg.

Today, large vertically-integrated companies invest in the different levels of electric power economy for the following reasons. Due to the increase in number of the producers from alternative energy, the share of vertically integrated companies in the electricity market slightly decreases. At the same time, the vertically integrated companies themselves sell the large fossil fuel-fired power plants to focus on the distribution and sales of electricity to the end consumer. Power plants are acquired by foreign investors, as well as by the communal enterprises.

This is because electricity purchase prices on the European Energy Exchange - "EEX" in Leipzig are steadily falling. In 2015 year, the price for the supply of electricity on the spot-market averaged 31.61 euros per MWh. Simultaneously the price of electricity for households was calculated at 29.51 cents per kWh and industrial electricity prices was 19.79 cents per kWh [1],[3]. In other words, the final consumer pays 7-10 times more than the purchase prices for electricity from electricity producers on the exchange.

It is worth noting, that just over half the price paid by retail electricity consumers in Germany is composed of taxes and fees, which in Germany are the highest in Europe. Taxes and fees in Europe amount to 33 percent of the monthly power bill for retail consumers. An essential part of the price for the final consumer is also formed by network charges – so-called "Netzentgelte". For households in 2015 year, they amounted to 6.71 cents per 1 kWh. This is a quarter of the price of electricity for the retail electricity consumers [3].

Vertically integrated companies are selling their assets in power generation sector. So, one of the modern coal-fired power stations in Germany "Schwarze Pumpe" equipped with carbon capture, built in 1997 year, in 2016 year was sold to the Czech concern "Energetický a průmyslový holding" - "EPH". Together with the "Schwarze Pumpe", Vattenfall got rid of the "Jämschwalde" and "Boxberg" coal-fired power plants. "Vattenfall" sold his own shares in the modern coal-fired power plant "Lippendorf" which was built 2000 (another owner is "EnBW" concern). Due to the unfavorable market many power plants that use coal and uranium fuel are closed.

The impact of vertically integrated companies on the distribution network business can be illustrated by the following example. The largest Distribution System Operator in Germany named "Westnetz" is a 100% subsidiary of "Innogy SE" (parent company of "Innogy SE" is "RWE"). The impact of companies "E.On" and "EnBW" on the distribution network business is also formidable [4].

In order to compensate losses of system operators by the networks expanding and operation, representatives of legislative power in Germany introduced the network charges - so-called "Netzentgelte". They grow every year because the power system is not ready to accept additional volumes of "green" electricity.

Following the energy policy of Germany, vertically integrated companies were involved in the development of renewable energy industry.

The company "E.ON" took radical measures. In 2016 year "E.On" founded a separate company "Uniper", that assumed control of the German energy giant's fossil fuel assets. In 2018 year "E.ON" will sell its remaining

stake in "Uniper" to Finnish state-controlled utility "Fortum". "E.ON" will focus on renewables and energy networks. The leadership of "E.ON" wanted also to split off nuclear operations from renewable energy operations. But under political pressure E.ON has abandoned plans to separate nuclear energy operations from renewable energy production. Currently the subsidiary enterprise "PreussenElektra" of "E.On" operates nuclear power plants all over Germany. The life of nuclear reactors in Germany is limited, and the construction of new reactors is not envisaged. Thus, over time, "E.On" will probably be involved only in renewables and energy networks business.

The companies "RWE" has allocated from its structure a subsidiary company "Innogy", which will be develop renewable energy power generation projects. Companies "Vattenfall" and "EnBW" implement renewable energy projects; in particular, they construct offshore wind farms.

Vertically integrated companies are responsible in modern Germany for the construction of large wind farms. For example, one of the largest wind power parks in Germany, "Nordsee Ost", with a capacity of 295 MW, located in the North Sea, belongs to "RWE Innogy". Nearby is the wind farm "Amrumbank West", owned by "E.On". 51% of the shares in the wind farm "DanTysk" belong to the company "Vattenfall", 49% - to the communal enterprise "Stadtwerke München". "EnBW" has built one of the most powerful wind parks "EnBW Baltic 2" in the Baltic Sea.

## **5 DISCUSSION CHANGE IN THE ROLE OF THE LOCAL AUTHORITIES IN THE ELECTRIC POWER MARKET IN GERMANY**

At the first stage of the liberalization the communal enterprises lost their market share and joined vertically integrated companies. Vertically integrated companies could combine in their structure any levels of electric power economy - generation, transmission, distribution and sale. However, today the role of local authorities and the communal enterprises created by them is changing. Municipalities have one important advantage over all other participants in the electricity market. The German networks business is based on long-term concessions granted by municipalities in the network area. Maximum period of concession contract is 20 years. Losing an expiring concession triggers a mandatory disposal of assets to concession holder. In 2015, the term of many concessions expired. To renew or to terminate the concessions is the task of the municipalities. They have opportunity to deliver electricity to the consumer on their own [11].

After selling off their electricity and gas networks to large energy corporations in the early 1990s year, small towns in Germany must pay a financial consideration in return back their Infrastructure. Because of lack of finances it is difficult. Small towns in Germany are now banding together to buy back their energy infrastructure and to get into the energy market. Today the municipalities are involved in generation, network and sales of electricity.

For example, the company Thüga was created in the 19th century. At the turn of the 20th and 21st centuries Thüga issued shares. Because of the favourable conditions more than 100 municipalities from all over the country became its shareholders. The company does network business and sales electric power to the general public and industry.

Most of the combined heat-and-power plants in Germany belong to the communal enterprises, that is, in fact - to the local authorities. For example, the power plant «Kraftwerke Mainz-Wiesbaden AG» belongs to the companies «Mainzer Stadtwerke AG» and «ESWE Versorgungs AG». The last company, which is engaged in both electricity generation and sales, belongs to the city of Wiesbaden. Thus, it is the example of successful collaboration between leadership of Mainz and Wiesbaden which allowed taking controls the generation and the sales of electricity in the region.

## **6 CONCLUSION**

The liberalization led to the electricity market changes. The implementation of German renewable energy support policies allowed entering the market new electricity producers. However, we discover the excess supply of electricity generated from renewable energy sources on the market. Consequently Germany is forced to change the laws and to limit the construction of new renewable power plants.

The target of the renewable energy policy in Germany was to reduce greenhouse gas emissions in the electricity sector. However, Germany spent a lot of money for renewable energy support. These measures allowed reducing the energy dependency of Germany on energy imports, particularly of oil and natural gas. The authors note that in recent year's electricity production in coal-fired power plants has increased.

The regime of the unbundling required vertically integrated companies to separate legally the transmission activities from their other activities so that one of these functions was carried out by a separate company. In

addition, vertically integrated companies are selling the large fossil fuel-fired power plants to concentrate on other levels of the electric power economy. But vertically integrated companies retain their monopoly position on the market under the altered circumstances. They are involved in the development of renewable energy industry, network business, as well as the sale of electricity.

Municipalities are involved in the process of business integration and they try to increase their market presence, both in electricity generation and in sales. Thus, the role of local authorities and the communal enterprises created by them - the so-called "Stadtwerke" - in the electric power industry in Germany is changing.

Currently communal enterprises and distribution system operators implement decentralized energy schemes. They try to produce electricity as close as possible to the consumer, to monitor changes in demand and supply and to redistribute electricity flows. But for a success they need to cooperate with other electricity suppliers operating in Germany and Europe to support uninterrupted power supply.

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