

Evaluating the level of economic security of the EU energy markets

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Abstract

The research encompasses analysing the conformity of profiles of energy strategies approved by the EU member countries, with criteria of security in the energy market determined by the requirements of the current European energy legislation. To assess the level of economic security of energy markets, it is proposed to rank national energy markets according to economic security indicators, taking into account the structure of energy markets in terms of participants and functions. This enables to objectively streamline the markets of electricity of the EU member countries in the form of ranking for ascertaining their positions under conditions of creating a single competitive energy market.

Keywords: economic security, energy market, strategy, evaluation, ranking

Introduction

The transformation of the European energy system is a planned measure accompanied by a technological process, which mainly creates new opportunities for production, transportation, and consumption of energy. Strengthening regulation of the energy markets shifts the focus towards ensuring the reliability of energy supply, creating a competitive internal energy market, and decarbonisation of the sector of electricity. Simultaneously, the architecture of the energy markets promptly changes owing to the redistribution of roles between the main participants and to introducing new institutions. Therefore, ensuring the economic security of the energy markets of the EU member countries, which shapes a considerable number of criteria to be revealed and assessed, underpins cardinal transformations.

However, the issue of assessing the economic security of energy markets as meso-economic systems has not been adequately raised in scientific research. Instead, researchers, depending on the objectives of the study, formed the list of

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indicators to assess and compare the level of energy security: the provision of alternative sources of supply, the identification of alternative energy routes and securing existing sources and transport networks (Popescu, 2015); GDP per capita, country risk, carbon intensity, energy intensity, final energy consumption per capita and electricity prices (Filipović *et al.*, 2018); the diversification of primary energy sources, imports (dependence on foreign energy sources and diversity of the origin), a country's risk factor associated with the origins of that country's energy imports (Matsumoto *et al.*, 2018). In this article, the set of indicators reflecting the level of economic security of the energy market has been expanded and adapted to the requirements of the EU energy legislation.

The contribution of the study is reflected in the performed analysis of the economic security level of national energy markets of EU member states. In this context, several specific objectives of this paper are addressed in the different sections. The first specific objective, which is developed in the first section, is to analyse the national energy strategies of the EU countries, highlighting the objectives that correspond to this study and are aimed at protecting market relations. The second specific objective raises a methodical approach to evaluating the level of economic security of the national electricity markets, which requires special attention to the criteria and functional components, which is addressed in the second section. The third and final specific objective, developed in the third section, seeks to analyse the level of economic security of the national markets of electricity under conditions of prompt transformational processes and of creating a single competitive energy market.

The application of the system approach to research and the specification of a notion of economic security of an energy market have enabled to formulate its definition, which most appropriately corresponds to the goals of the research. For determining groups of energy markets in terms of reference points of the national energy strategies, the methods of abstraction, systematization and comparison were applied. Having used inductive, statistical, tabular, and graphic methods, analysis, and generalization, a comparative estimation of the level of economic security of the national energy markets in the context of their transformation was conducted.

1. The vector of reference points of the national energy strategies in terms of criteria of security in the energy market

A process of development of the competitive European market of electricity has intensified after the signing of the Treaty on the European Union in 1992. To provide the legal framework of the reformation process, the European Commission has adopted so-called energy packages – a set of European directives and corresponding rules.

Adopted in July 2009, the Third Energy Package, which includes the Directive 2009/72/EU (European Commission, 2009), determines the ways concerning the creation of a single European energy space based on new rules, particularly market

liberalization, ownership unbundling (separation of electricity generation from electricity transmission), enlargement of the cross-border interconnection, and centralized planning of development of the European energy market.

It is worth mentioning that integrational changes of energy markets significantly influence a system of economic interests of participants in the energy market and directions of their interrelations. As a result, a process of market transformation should be accompanied by ensuring the economic security of the national electricity markets.

Taking into account Directive 2009/72/EU (European Commission, 2009) requirements and goals of the research, we suggest defining a notion of economic security of an energy market as a set of terms for the functioning of an electricity market, particularly those caused by transformational processes, which provide protection of all participants' economic interests against real and potential threats grounded on principles of sustainable development. At the same time, a peculiarity of the examination consists in the formalization of the dynamical structure of a complex of conditions determining the evolution of a system, which allows impacting processes within an analysed system.

Drawing on the generally accepted reference points, EU member countries have adopted precisely determined strategies for the development of their own energy markets during the last years. Taking into consideration a wide range of directions for markets' development, the conformity of the national energy strategies with the criteria of security of the energy market was analyzed (see Table 1).

Table 1. Profile of national energy strategies in the view of the criteria of security in the energy market

Group	Country	Prices		Market concentration	Electricity consumption		Cross-border electricity interconnections *	Share of RES in the GFEC	Greenhouse gas emission	Market opening	Quality of energy supply	Diversification of energy sources
		HC	NC		Primary	Final						
1	Sweden	↑	~	□ ↓	↓	↓	✓	● ↑	↓	✓	●	●
2	Finland	↑	↑	● ~	↑	↑	✓	● ↑	↓	✓	●	●
3	Germany	↑	~	■ ↓	↓	↓	×	○ ↑	↓	✓	●	●
	Denmark	↑	↑	■ ↓	↓	↓	✓	○ ↑	↓	✓	●	●
	Spain	~	~	■ ↓	↓	↓	×	○ ↑	↓	✓	●	●

	Italy	~	↑	■↓	↓	↓	×	○↑	↓	✓	●	●
	Netherlands	~	~	■↓	↓	↓	✓	○↑	↓	✓	●	●
	United Kingdom	↑	↑	■↓	↓	↓	×	○↑	↓	✓	●	●
4	Austria	↑	~	●~	↓	↓	✓	●↑	↓	✓	●	●
	Belgium	~	~	□↓	↓	↓	✓	○↑	↓	✓	●	●
5	France	~	~	□↓	↓	↓	×	●↑	↓	✓	●	●
6	Latvia	↑	↑	□↓	↑	↑	✓	○↑	↑	✓	●	●
7	Estonia	↑	↑	□↓	↑	↓	✓	○↑	↑	✓	●	●
	Croatia	↑	↑	□↓	↑	↓	✓	●↑	↑	✓	●	●
8	Poland	↑	~	●~	↑	↑	×	●↑	↑	✓	●	●
	Romania	↑	~	●~	↑	↑	×	●↑	↑	✓	●	●
	Bulgaria	↑	↑	□↓	↓	↓	×	○↑	↑	✓	●	●
	Lithuania	↑	↑	□↓	↓	↓	✓	○↑	↑	✓	●	●
9	Czech Republic	~	~	□↓	↓	↓	✓	○↑	↑	✓	●	●
	Hungary	~	~	□↓	↓	↓	✓	○↑	↑	✓	●	●

Symbols:

HC - household consumers; NC – non-household consumers; * - target of 15% by 2030; ↑ - increase of an indicator; ↓ - decrease of an indicator; ~ - volatility of an indicator; – - no changes; ✓ - goal is accomplished; × – goal is not accomplished; □, ● – high level of an indicator; ● – medium level of an indicator; ■, ○ – low level of an indicator.

Market concentration: ■ - 0-1000 – competitive market; ● – 1000-2000 – moderately concentrated; □ – 2000-10000 – highly concentrated.

Share of RES: ○ – 0-20 – small share of RES; ● – 20-35 – moderate share of RES; ● – 35 and more – large share of RES.

Quality of energy supply: ○ – 1-3 – low; ● – 3-5 – medium; ● – 5-7 – high.

Diversification of energy sources: ● – 0 – 0,33 – high diversification; ● – 0,33-0,66 – moderate diversification; ○ – 0,66 – 1,00 – low diversification.

Source: authors' representation according to European Commission, 2008; 2009; 2014b

The formed profiles of national energy strategies following the requirements of the current EU legislation provide an opportunity to monitor and evaluate the progress of the energy market transformation. The selection of indicators common to national strategies makes it possible to compare them by target settings in terms of the concentration ratio, the share of renewable energy sources (RES) in the gross final electricity consumption (GFEC), quality of energy supply, the level of prices for household and industrial consumers, etc.

The conducted analysis of strategies enables to conclude that the energy policy of the EU is based on the differentiated distribution of obligations between the EU member countries. Taking into consideration the peculiarities of each energy market and their distinctive natural and resource potentials is a reason for such a process.

Hence, target indicators of national energy strategies partially differ for each country but, simultaneously, correspond to the established goals of the EU concerning energy and climate in particular. Thus, in order to determine uniform reference points of the national energy strategies, the typological division of the countries' energy markets is proposed (see Table 2).

It is worth mentioning that the Energy Roadmap 2050 (European Commission, 2011) determines the energy efficiency, renewable energy, and decarbonisation as priorities of development of the internal energy market of the EU. International community shows an obvious interest in reliable energy conservation, tackling climate changes and their consequences, the rational use of ecosystems, etc. The 17 Sustainable Development Goals for the period 2015-2030 (United Nations, 2015), adopted at the United Nations Summit 2015 are evidence of this fact. Since sustainable consumption and production of electricity are stimulating the efficiency of the use of resources, this determining the reduction of the future economic and ecological expenses, enhancing economic competitiveness and ensuring the economic security of the national energy markets.

Table 2. Grouping of the energy markets of the countries in terms of reference points of the national energy strategies

№	Name of a group	Countries	Characteristics of a group	Representative country
1	Protagonists (main leaders)	Sweden	Annual decrease of the market concentration level by 3.5% on average fosters the gradual transition to a category of competitive markets. The strategy is focused on sustainable development. Hence, a goal is to achieve the zero and, later, the negative value of the level of emission of greenhouse gas, particularly owing to 100% renewable energy, up to 2045. An interim goal contemplates that the share of RES will be at the rate of 49% (the highest level among European countries) up to 2020	Sweden
2	Deuteragonists (secondary main leaders)	Finland	One of the largest shares of RES and active reduction of influence on ecology (-16% of greenhouse gas emissions) and the simultaneous growth of amounts of energy consumption. A reason is a cold climate, long distances for transportation of electricity, and location in the territories of numerous energy-intensive industrial enterprises, the share of which in general consumption reaches approximately 50%	Finland
3	Trendsetters (those setting trends)	Germany, Denmark, Italy, Spain,	Liberalization of the national energy markets, which have been among the first to achieve the level of openness at the rate of 100%. The low	Germany

		Netherlands, United Kingdom	level of concentration indicates the absence of barriers to entry to a market place and the high level of competition	
4	Progressives (advocates of progressive ideas)	Austria, Belgium	The progress in the increase of competition in electricity markets due to integrity with neighbouring countries. A decrease in the use of fossil energy in favour of renewable energy sources stipulates the reduction of greenhouse gas emissions	Austria
5	Progressive traditionalists	France	High market concentration is stipulated by the maintenance of a monopolistic position of the state-owned vertically integrated company Electricité de France (EDF). Nevertheless, supporting government regulation of the industry has led to the progress of the energy market in the process of liberalization, especially owing to repealing regulated tariffs and adopting the law on RES. At the same time, abandoning the coal-fired generation (up to 2021) stipulates a significant reduction of greenhouse gas emissions	France
6	Conservators	Latvia	The highest level of market concentration accompanied by an increase in energy consumption and amounts of emission of greenhouse gas	Latvia
7	Renovators (those renovating old things)	Estonia, Croatia	The growing interest in the problem of energy efficiency. The low level of efficiency has resulted in the yearly growth of amounts of energy consumption due to amortization of physical facilities, energy-intensive industrial enterprises, etc. Therefore, the authors consider a sector of final consumers, which consumes the largest share of energy, as a prior one	Croatia
8	Accommodators (those adjusting to an environment)	Poland, Romania	Increasing demand for energy, the growth of greenhouse gas emissions, and the increment of prices for fuels foster interest in alternative energy sources	Romania
9	Sublimators (those changing a direction)	Bulgaria, Lithuania, Czech Republic, Hungary	National energy strategies are oriented towards the reduction of energy consumption and the increase in the energy efficiency of the economy. The gradual decrease of market concentration is accompanied by an increase in the percentage of RES. Nonetheless, the dominant use of fossil energy (coal and oil) is a source for growing emissions of carbon dioxide	Lithuania

Source: authors' representation

The information given in Table 2, ideas for energy strategies of various groups of countries, differ from each other to some extent. However, the strategies of

countries inside of each group are common and their views regarding the development of the national energy markets coincide. Thus, there is a clear list of leading countries in the context of implementing energy legislation of the EU – “protagonists”, “deuteragonists”, “trendsetters”, and countries where harmonization of internal law with the EU law has occurred more recently. Such countries form the groups of “sublimators” and “accommodators”. The grouping made it possible to identify 9 representative groups of countries for further analysis and evaluation of the effectiveness of national energy strategies.

2. The methodical approach to evaluating the level of economic security of the national electricity markets

The orientation of the EU towards the transformation of the electricity markets stipulates the necessity of an appropriate evaluation of the economic security of the national energy markets. Therefore, under such evaluation, it is important to take into account not only the specificity of the market but also the criteria of economic security and their indicators determined according to the goals of the EU energy policy.

Taking into consideration a wide range of matters to be encompassed, we propose to apply the methodical approach, consisting in ranking the national energy markets, which is based on criteria of economic security, in order to evaluate the level of economic security of the energy markets. To conduct an evaluation, the following three criteria were used: “Independence of rivalry”; “Satisfying interests of parties concerned”; “Transparency of information” (see Table 3). Twelve representative indicators grouped into five components of economic security, which enable to comprehensively encompass activities of all the participants in the market, including consumers, suppliers, and generation companies, present the above-mentioned criteria.

The criterion “Independence of rivalry” consists of two components of economic security of the electricity market: interface and international economic components. To analyse the former, a set of interrelated indicators describing a degree of competition between generation corporations, as well as between retail companies, has been used. Since consumers play a key role in the market structure, it is necessary to disclose their behaviour in the context of the ability to choose between suppliers.

The international economic component of economic security implies an indicator at the level of the cross-border interconnection, which allows to increase sources of supply and, hence, to form more competitive prices in the national markets.

To disclose the criterion “Satisfying interests of parties concerned”, we have applied financial and technical components of economic security. The financial component emphasizes the purchasing power of consumers, as well as the necessity for the operative reaction to changes in prices for electricity. The technical

component comprises indicators characterizing expediency and the appropriate technical status of electrical grids and quality of power supply.

Table 3. Indicators of economic security of the electricity market

№	Criteria of economic security	Component of economic security	Indicator	Target feature
1	Independence of rivalry (K_1)	Interface (IF)	Market concentration index - power generation	→ min
			Market share of the largest generator of electricity	→ min
			Total number of electricity retailers to final consumers	→ max
			Switching rates of household customers	→ max
		International economic (IE)	Cross-border electricity interconnection	→ max
2	Satisfying interests of parties concerned (K_2)	Financial (FC)	Electricity price volatility	→ min
			Share of average salary spent on electricity	→ min
			Mark-up in retail electricity for household consumers	→ max
		Technical (TC)	Electric power transmission and distribution losses	→ min
			Quality of electricity supply	→ max [0;7]
	Access to electricity	→ max [0;100]		
3	Transparency of information (K_3)	Informational (IM)	Ability to compare electricity price easily	→ max [0;10]

Source: authors' representation

The criterion “Transparency of information” implies an indicator to ease comparing suppliers' prices by consumers, awareness of which directly influences the opportunity of satisfying own interests. Transparency looks at the essence of a quality environment, in which real and potential stakeholders will be able to obtain necessary information, analyse it, and correct their own behaviour, thus increasing efficiency.

The methodical approach to evaluating the level of economic security of the energy markets scans the comparison of the factual values of indicators of economic security with corresponding “reference” values in other researched countries.

It should be noted that the data underlying the proposed indicators are expressed in different units of measurement. For instance, some of them are expressed in the percentage form (a market share of the largest generator of

electricity, the switching rates of household customers, etc.), the others – according to the determined scale (quality of power supply – from 1 to 7, a market concentration index – from 0 to 10000), while several indicators – in absolute terms (total number of electricity retailers to final consumers). In order to join various indicators into a single index, they should be normalized in advance. We have chosen to rank as a method for normalization of different indicators among alternative methods for converting indicators into a common format. Owing to this method, the positions of each examined national energy market may be objectively arranged in the form of ranking in compliance with the given indicators.

Thus, determining ranks of the indicators, i.e. an amount of points according to their purpose, is one of the most essential elements of evaluating the economic security of the national markets. Simultaneously, the highest rank 9 is assigned to a national market, the value of an indicator which best responds to a target characteristic among the other markets. Correspondingly, the lowest rank 1 is assigned to an energy market, the value of an indicator which, to the least extent, responds to a target characteristic among the other energy markets.

In a case when the values of the evaluative indicators are equivalent in terms of several national markets, these values are arranged according to the 1224 principle. In other words, similar points are assigned to equal values, creating a so-called gap. A final step consists in ranking based on simple numerical codification, which takes into account the number of such gaps.

To obtain an estimate for each component of economic security of the national electricity market, the following formula was used:

$$S_j = \sum_{i=1}^n I_i^j \quad (1)$$

where S_j – general estimate for a j -component of economic security;

I_i^j – estimate according to an indicator of a j -component;

n – number of indicators of a j -component.

Hence, a general point estimate of economic security of the national electricity markets is calculated as a sum of general estimates for all the components:

$$Z_N^{ES} = \sum_{j=1}^m S_j \quad (2)$$

where Z_N^{ES} – general point estimate of economic security of a N -national electricity market;

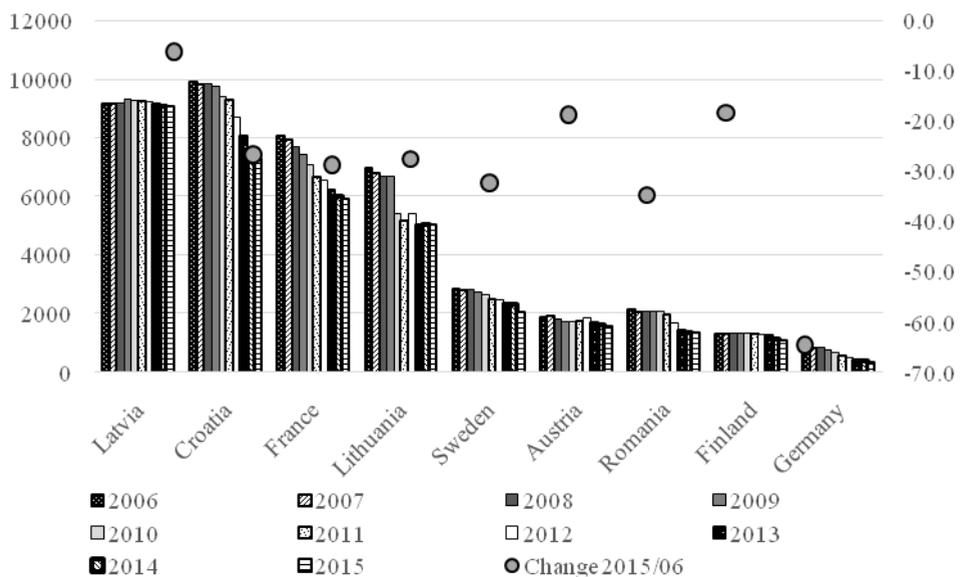
m - number of components of economic security.

According to the proposed methodical approach, the general estimate of economic security of an energy market may achieve the maximum value at the rate of 108 points. This means that it was assigned the maximum point 9 to the examined electricity market according to all the evaluative indicators.

3. Analysing the level of economic security for the energy markets of the EU member countries

Thus, during 2005-2015, the concentration ratio for the national energy markets calculated on the basis of the Herfindahl-Hirschman Index has decreased in all the researched countries (from -5.7% in Latvia to -61.4% in Germany). This facilitated a general reduction of this ratio in the EU-28 by 2.1% (see Figure 1).

Figure 1. Market concentration index - power generation



Source: authors' representation based on data from European Commission, 2018

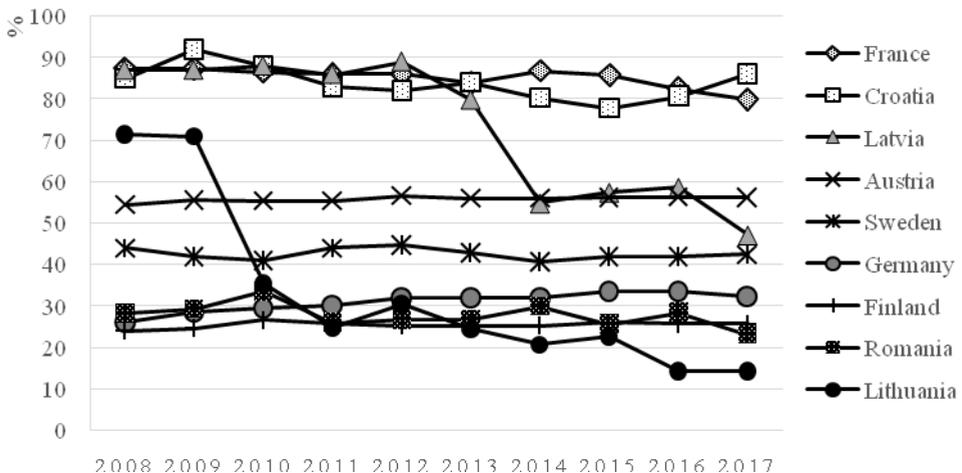
The low-concentrated energy market of Germany is the leader in the development of competition in the sector of electricity (377,9). In 2015, the electricity markets of Finland (1088,0), Romania (1367,5), and Austria (1600,6) were moderately concentrated compared with the other elements of the research sample. The markets of electricity generation of the remaining six countries are highly concentrated. The highest level of concentration is inherent to Latvia (9080,26) and Croatia (7304,97).

Correspondingly, in order to rank the countries according to the determined indicator, an estimate increases in proportion to the level of market concentration: 9 is assigned to the country with the lowest level of concentration, namely Germany, whereas the minimum estimate 1 is assigned to Latvia – a country where the

generation of electricity is the most concentrated. We follow the analogical logics of assigning points in the process of analysing further indicators in compliance with their target characteristic presented in Table 3.

An analysis of statistical data has shown that the percentage of the largest producer of electricity in Lithuania in 2017 accounted for 14.2% while in Croatia it accounted for 86.1% (6.1 times higher) (see Figure 2). Hence, in the markets with a low level of concentration and, correspondingly, with a high competition level, there is no monopolistic influence of certain generation companies on the general market conjuncture.

Figure 2. Market share of the largest generator of electricity

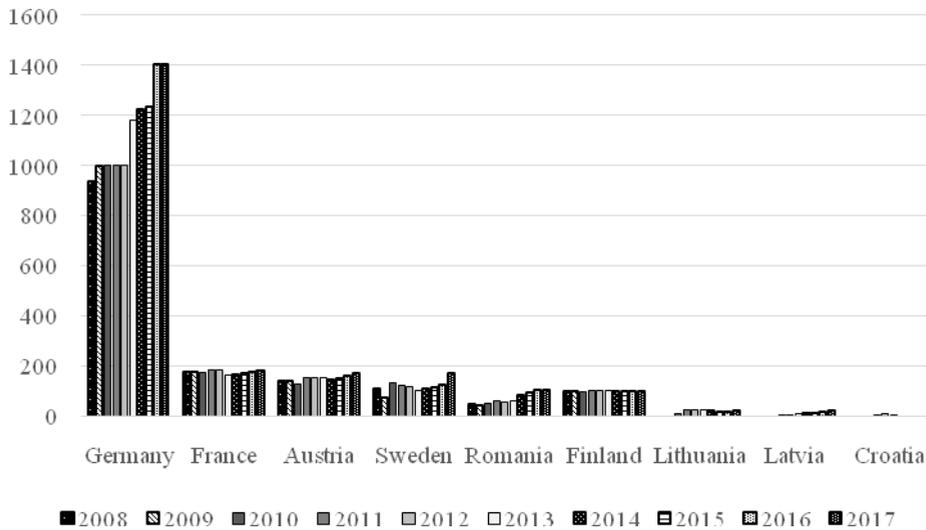


Source: authors' representation based on data from Eurostat, 2018a

Consequently, the lower the level of a concentration ratio for the market of electricity generation and a market share of the largest generator of electricity in a total amount of generation, the higher the level of economic security of the market.

Assessing the state of competition in the retail electricity markets is of considerable importance in fostering the interests of electricity consumers. Consumers may choose among several energy contracts and retail suppliers of energy to find the best proposition at an appropriate price.

In 2017, the largest number of retail suppliers of electricity to final consumers operated on the territory of Germany (1404). This figure exceeds eight times a similar figure registered in France, which ranked second in terms of the number of suppliers (185) (see Figure 3). Latvia (26), Lithuania (22), and Croatia (9) pertain to a group of countries with the lowest number of retail suppliers of electricity.

Figure 3. Total number of electricity retailers to final consumers

Source: authors' representation based on data from Eurostat, 2018a

An ability of competition to encourage efficient expenses for supply stipulates the importance of competition in a market because retail suppliers have an incentive to decrease prices for involving consumers and none of the retail suppliers is able to control prices or get extra profits on a sustained basis.

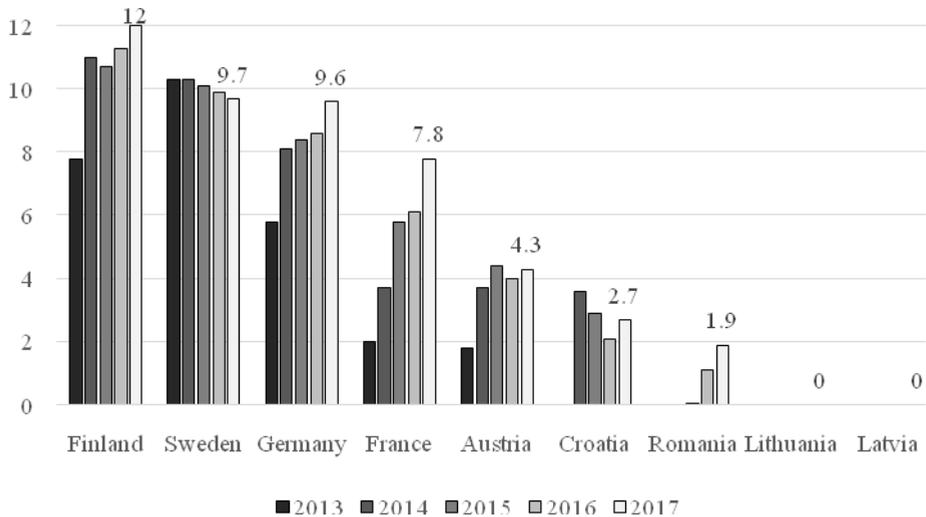
Taking into account the fact that electricity is actually a uniform commodity, suppliers also compete in terms of service quality (particularly, servicing customers). This conduces to the suppliers' development of marketing activity and differentiation of contracts proposed for meeting consumers' demand. This is related to competitive escalation between competing firms for involving and keeping customers. Therefore, a competitive market will have a high level of independent rivalry and, correspondingly, the economic security of the market.

Thus, to maintain a reducing pressure on prices and to encourage a high quality of servicing, consumers are able to choose between alternative suppliers on their own. Nevertheless, it should be noted that the levels of consumer switching significantly differ among EU member states (see Figure 4). Despite simplification of regulation and automatization of processes in many member countries, there is a large number of households which do not switch electricity suppliers.

For instance, during the analysed period, the absence of the practice of switching in Lithuania and Latvia was observed. This tendency may be partially explained by applying regulated prices for household consumers. The highest

coefficient of switching within the research sample of countries has been observed in Finland (12%). Sweden (9.8%) and Germany (9.6%) are also among leaders.

Figure 4. Switching rates of household customers

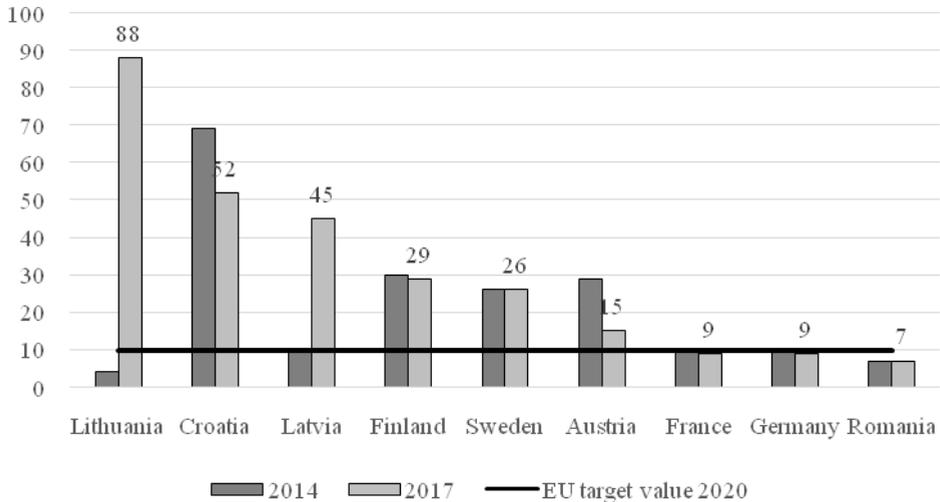


Source: authors' representation based on data from CEER, 2018

It is worth mentioning that the low level of switching is not an obvious feature of the low level of economic security. A reason for the abandonment of switching may consist in insufficient incentives for switching (a fee for switching, complicated and durable procedures of switching, etc.), as well as behavioural aspects (loyalty to a supplier, absence of confidence in new suppliers, etc.).

Interrelated infrastructure, i.e. cross-border electricity interconnections, is a key condition for an integrated and competitive internal market. Within the research sample, three member countries are insufficiently connected to the electricity market of the EU (the level of cross-border interconnections is lower than a target indicator of the EU determined for a period up to 2020) (see Figure 5). These countries include Romania, Germany, and France. It should be noted that the insufficient interrelation impedes competition, increases consumer expenses, and fosters vulnerability from the standpoint of energy security.

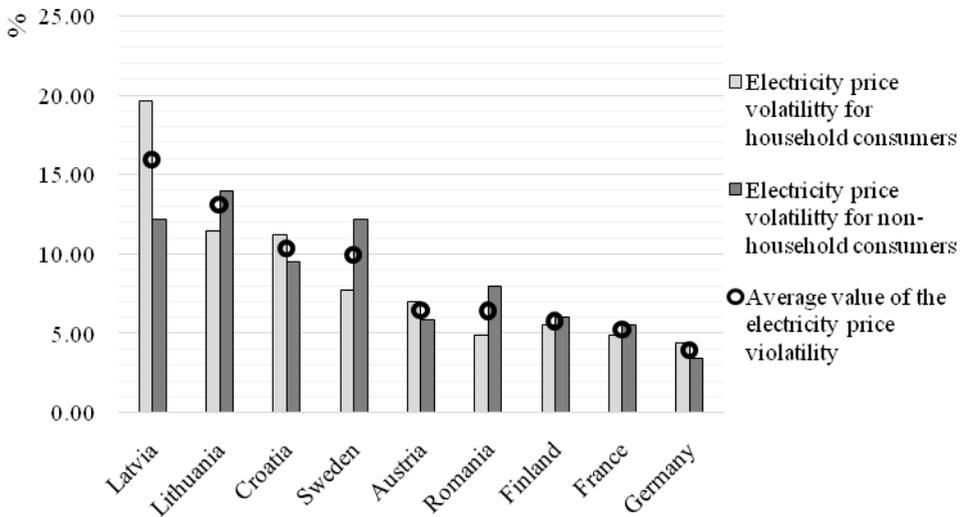
The growth of cross-border connections of Lithuania and Latvia is stipulated by long-standing regional cooperation under the Baltic Energy Market Interconnection Plan BEMIP. The appearance of "Nordbalt" (Lithuania – Sweden; 700 MW) and "Litpol Link" (Lithuania – Poland; 500 MW) – new electricity interconnections – have effectively ended the energy isolation of the Baltic States and connected them with the rest of Europe (European Commission, 2017b).

Figure 5. Cross-border electricity interconnection

Source: authors' representation based on data from European Commission, 2017a

The price level is undoubtedly an important element in understanding the economic security of the market. Nevertheless, in the case of retail energy markets, the prices for final consumers consist of several components, some of which are subject to government regulation (for instance, network expenses, taxes, fees). In such cases, distinctions between prices for a final consumer in different countries may be stipulated by exclusively legitimate differences rather than peculiarities of competition. Therefore, in the process of calculation of the economic security of the electricity market, we suggest using an indicator of price volatility (a standard deviation for a certain period) rather than that of the price level.

An analysis of the volatility of retail prices during 2008-2017 shows that the largest deviation of prices for household consumers has been in Latvia (19.7%) while the most considerable deviations of prices for non-household ones have been in Lithuania (14.0%) (see Figure 6). At the same time, the least considerable changes of prices for household consumers and non-household ones have been in Germany (4.4% and 3.4%, respectively). Such inconsiderable fluctuation of prices facilitates the economic security of the electricity market because they stipulate the ability of their participants to prognosticate future tendencies and to make strategic decisions.

Figure 6. Electricity price volatility, 2008-2017

Source: authors' representation based on data from Eurostat, 2018b; 2018c

Conversely, a dramatic change of prices for electricity leads to the necessity for an operative reaction on the part of both generation companies and consumers. This results in a decrease in real incomes of household consumers and, correspondingly, in an increase in expenses for buying electricity. There is a significant difference between EU member countries in terms of financial affordability of electricity for household consumers stipulated by income (the share of energy expenses is smaller at a higher salary rate) and climate (warmer climate implies a smaller share of energy expenses). For example, a share of the average salary spent on electricity in Sweden is the largest within the sample of countries and reaches 2.34%. In turn, the smallest share of expenses for electricity within the research sample pertains to Poland (0,55%). Within the research sample, the smallest amounts of electricity consumption per year are also inherent to Polish consumers (761,4 kilowatt-hour/year) (see Table 4).

Thereby, the growth of retail tariffs at an unchanged amount of electricity consumption intensifies the financial burden for consumers, creating the threat of debt owed to suppliers. In turn, the reduction of amounts of consumption will lead to the necessity for rapid balancing of current productive capacities in accordance with new requests. Therefore, considerable changes in retail prices for electricity, as well as the increase of a share of expenses for it in an amount of consumer salary result in the imbalance of market demand and supply and, subsequently, in the decrease of the economic security level of the market.

Table 4. Share of average salary spent on electricity, 2017

No	Country	Average electricity consumption per capita, kilowatt-hour/year	Electricity prices for household consumers, euro/kilowatt-hour *	Average wage, euro	Share of average salary spent on electricity, %
1.	Sweden	4470.27	0.1993	29580	3.01
2.	Croatia	1461.41	0.1236	9504	2.13
3.	Latvia	880.97	0.1582	8436	1.90
4.	Finland	4013.63	0.1599	30108	1.72
5.	Germany	1541.09	0.3048	27240	1.70
6.	Austria	2071.56	0.1978	24108	1.65
7.	France	2354.13	0.1756	22884	1.60
8.	Romania	552.85	0.1289	6180	1.38
9.	Lithuania	950.34	0.1107	7644	1.15

Note: * - a tariff rate is indicated in accordance with average consumption of electricity in a country per capita

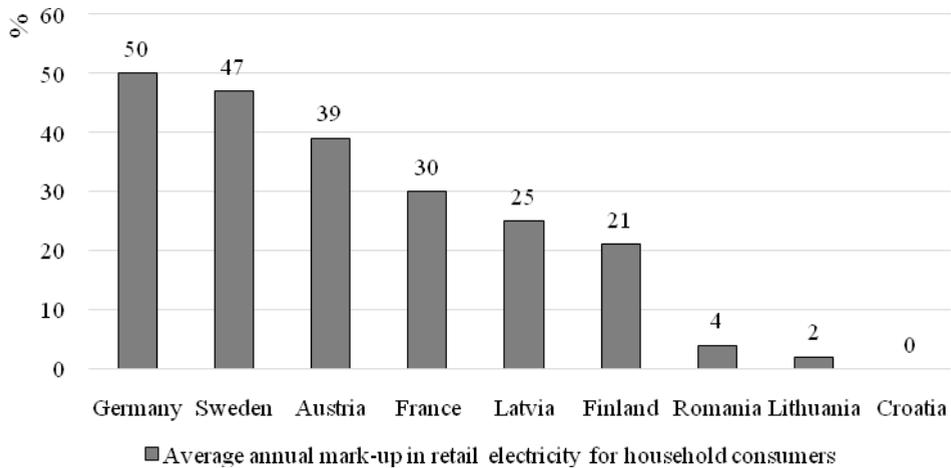
Source: authors' representation based on data from Eurostat, 2018b; 2018d; OECD, 2018

An amount of the mark-up on the retail price in the retail electricity market is an expression for a criterion of satisfying interests of electricity suppliers. This indicator is defined as the difference between wholesale energy costs and the energy component of retail prices. It is worth mentioning that the mark-ups are not the same as profits as suppliers have to pay additional operational costs (e.g. marketing, sales, customer services, overheads etc.) in bringing a product to market (ACER/CEER, 2015, p.71).

The level of the mark-ups of electricity suppliers is the appropriate expression of the competition level. If the activity of suppliers is highly profitable and there are no significant barriers to entry, new companies have an opportunity to earn a profit. As a result, they enter the market. Figure 7 shows that the average mark-ups in the retail electricity markets widely vary in different EU countries: the highest level of the mark-ups in the sector of households has been observed in Germany (50%) and Sweden (47%), the lowest level – in Lithuania (2%), and zero level – in Croatia.

Regulating prices for a final consumer (Croatia), which leads to the zero-level of the mark-up of suppliers, can seem attractive for consumers in a short period. Nevertheless, the growth of the average level of the mark-ups of suppliers in a retail price of electricity will facilitate new suppliers to enter the market. In turn, this will cause a flow of investments into the energy sector and enhancement of the economic security of the market.

Figure 7. Average annual mark-up in retail electricity for household consumers, 2017

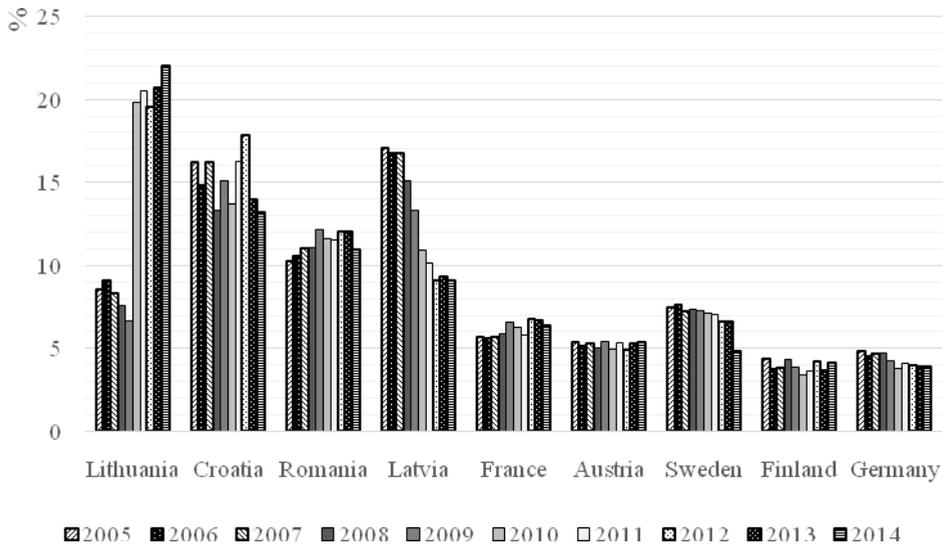


Source: authors' representation based on data from ACER/CEER, 2018

A technical component, a population's access to electricity (the percentage of the population which has stable access to electricity) is of particular importance in assessing the economic security of the electricity market. In 2017, there is a maximum possible 100% rate of electrification of the population in all the researched countries. This figure expresses an opportunity of the countries to guarantee equal access of all the consumers to electricity. Hence, in the process of ranking, maximum point 9 is assigned to the whole sample of countries.

Nonetheless, the percentage of electric power transmission and distribution losses in a general output of energy generation varies within the sample of countries. From the standpoint of economic security, the decrease of losses becomes increasingly important for ensuring the financial stability and for enhancing the quality and reliability of the system.

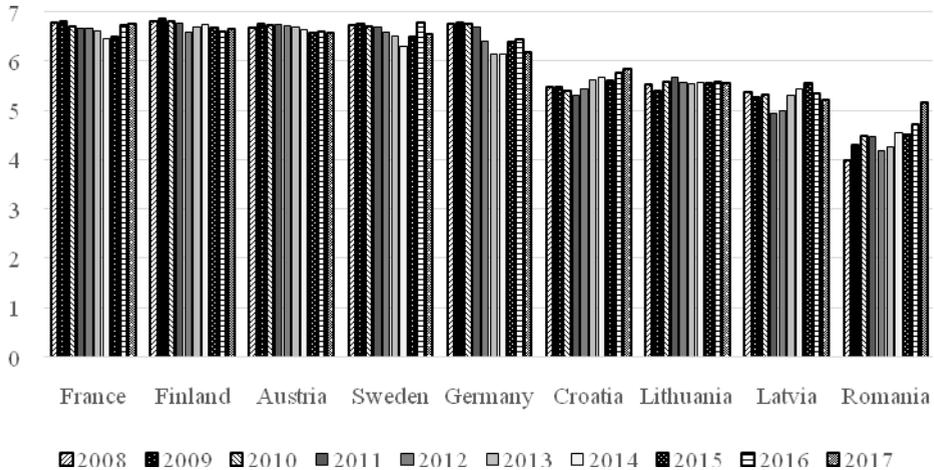
The largest losses of electricity among the representative sample of countries has been observed in Lithuania since 2011. In 2014, they equalled approximately one-fourth of a general output of electricity generation – 21.98% (see Figure 8). Such considerable values of the indicator express the necessity for reconstruction or replacement of transmission lines and transformers.

Figure 8. Electric power transmission and distribution losses (% of output)

Source: authors' representation based on data from World Bank, 2018

According to the methodology of the World Bank, a criterion of supply reliability (lack of interruptions), which indicates the quantity and duration of interruptions, describes the quality of electricity supply. This indicator is measured on a scale from 1 to 7, where 1 describes very unreliable electricity supply to final consumers and 7 describes a very reliable supply, respectively. Although regulation of quality in the EU countries aims at the same major goal, consumer protection, the search for means of improving the general quality and undertaken strategies differ in the researched countries. Correspondingly, this tendency affects the level of an indicator of electricity supply quality (see Figure 9).

Hence, in 2017, the French energy system provided the best quality of electricity supply among the representative sample of countries. The indicator of France did not fall below 6.47 during 2008-2017. Finland (6.67), Austria (6.58), and Sweden (6.56), which have a high level of this indicator, rank second. Within the sample, Latvia (5.22) and Romania (5.16) have the lowest level of quality of electricity supply. However, the most considerable pace of growth of the indicator during the examined period (29.3%) is inherent to the latter. This shows positive shifts in servicing consumers.

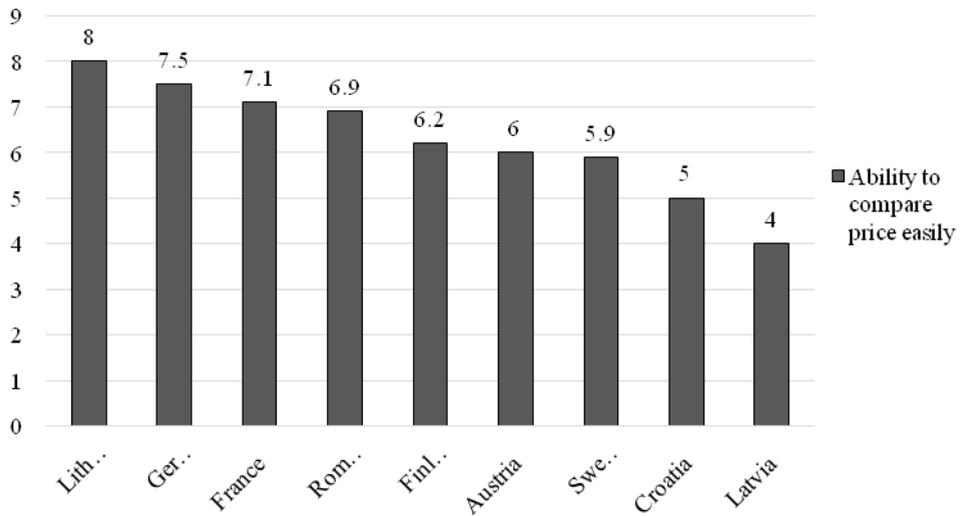
Figure 9. Quality of electricity supply

Source: authors' representation based on data from World Bank, 2017

The research of the ECME Consortium (2010) on the retail electricity markets has ascertained that many consumers have no access to relevant information on energy markets. The ability to compare prices of suppliers is crucial to the further development of the national energy markets because it enables consumers to actively participate in this process by switching between suppliers in order to benefit.

The results of a survey regarding the simplicity of comparing the prices of suppliers, conducted among household consumers, enable us to draw the following conclusions: the highest value on a scale from 0 to 10 (where 10 is very easy to compare) has been assigned to Lithuania (8.0) and Germany (7.5). This means that consumers in these markets are able to easily make substantiated decisions on the change of a supplier, taking into account their own interests. In contrast to these countries, difficulties in comparing prices are observed in Latvia (4.0) and Croatia (5.0) (see Figure 10).

Drawing on the results of the analysis of the national energy markets in terms of each indicator, we have arranged them and, subsequently, ranked the national energy markets by the level of economic security (see Table 5).

Figure 10. Ability to compare electricity price easily, 2013

Source: authors' representation based on data from IPA Advisory Limited, 2015

Table 5. Ranking of national energy markets in terms of economic security

№	Criteria of Component of economic security	Indicator	Austria	Croatia	Finland	France	Germany	Latvia	Lithuania	Romania	Sweden
1	K1	Market concentration index - power generation	6	2	8	3	9	1	4	7	5
		Market share of the largest generator of electricity	3	1	7	2	6	4	9	8	5
		Total number of electricity retailers to final consumers	7	1	4	8	9	2	3	5	6
		Switching rates of household customers	5	4	9	6	7	1	1	3	8
			Total IF	21	8	28	19	31	8	17	23
	IE	Cross-border electricity interconnection	4	8	6	3	2	7	9	1	5
		Total IE	4	8	6	3	2	7	9	1	5

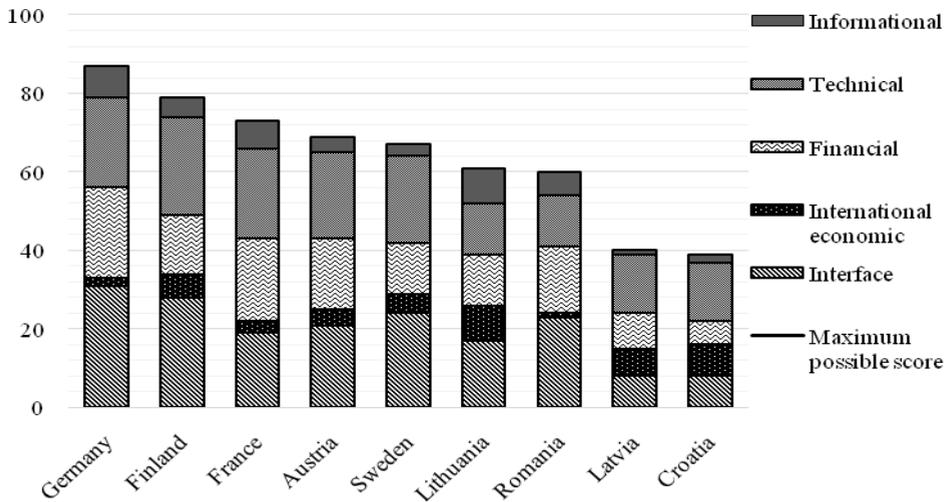
Total «Independence of rivalry»			25	16	34	22	33	15	26	24	29	
2	K2	Electricity price volatility	5	3	7	8	9	1	2	6	4	
		Share of average salary spent on electricity	6	2	4	7	5	3	9	8	1	
		Retail mark-ups in the household segment	7	1	4	6	9	5	2	3	8	
Total FC			18	6	15	21	23	9	13	17	13	
2	TC	Electric power transmission and distribution losses	6	2	8	5	9	4	1	3	7	
		Quality of electricity supply	7	4	8	9	5	2	3	1	6	
		Access to electricity	9	9	9	9	9	9	9	9	9	
Total TC			22	15	25	23	23	15	13	13	22	
Total «Satisfying interests of parties concerned»			40	21	40	44	46	24	26	30	35	
3	K3	IM	Ability to compare electricity price easily	4	2	5	7	8	1	9	6	3
Total «Transparency of information»			4	2	5	7	8	1	9	6	3	
Grand Total			69	39	79	73	87	40	61	60	67	

Source: authors' representation

Germany has scored 87 points out of 108, Finland has scored 79 points, and France has scored 73 points. These countries are leaders in terms of the level of economic security of the electricity market. Such values are explained by the stable position of an institutional environment expressed in the high level of the interface and technical components of economic security. Nevertheless, the international economic component of economic security of Germany is at a low level. This means that the cross-border interconnection to the EU market is insufficient.

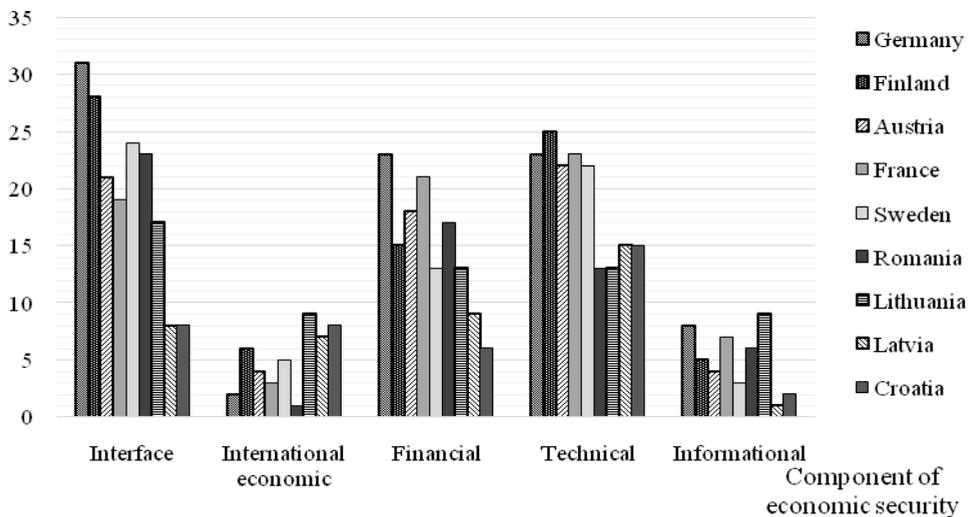
The results of ranking the researched national markets of electricity may be graphically presented for each energy market as well as for each component of economic security (see Figure 11, Figure 12).

Figure 11. Structure of the level of economic security of the national electricity markets



Source: authors' representation

Figure 12. Comparing the level of economic security of the national electricity markets by components



Source: authors' representation

In spite of the similar level of economic security, the electricity markets of Latvia (40 points) and Croatia (39 points) differ in terms of the level of certain components. The low level of the interface component is stipulated by recently initiated processes of transformation of the national markets and, hence, an adaptation of participants in the market to new conditions of functioning.

Conclusions

The conducted research showed that the differentiated distribution of obligations between the member countries within the EU energy policy leads to the emergence of distinctions between reference points of the national energy strategies. For this reason, the decomposition of national energy strategies affected by criteria of economic security constituted the grounds for grouping the energy markets in terms of identified uniform reference points. Thus, nine groups of the national energy markets were determined. This provided an opportunity to identify representative countries to monitor and assess the progress of energy market transformation. A sample of the study was made up of several EU countries – Sweden, Finland, Germany, Austria, France, Latvia, Croatia, Romania, and Lithuania. According to this classification, Sweden, referred to as “protagonist”, is the main leader in terms of electricity market development. Together with groups of “deuteragonists” (Finland) and “trendsetters” (Germany, Denmark, Italy, Spain, the Netherlands, United Kingdom), it unites the EU member countries, the energy markets of which develop in strict compliance with the approved energy legislation. In contrast to them, the groups of “sublimators” (Bulgaria, Lithuania, Czech Republic, Hungary) and “accommodators” (Poland, Romania) encompass the countries where the internal law has more recently been harmonized with the EU law.

The development of the methodical approach to evaluate the level of economic security of the national energy markets, which consists in ranking based on criteria of economic security of the energy market, is the scientific novelty of this research, too. In the process of determining the indicators of economic security, the energy market structure, in terms of participants and functions was considered. This provided an opportunity to comprehensively take into account the interests of the parties concerned, including consumers, suppliers, and generation companies. The suggested approach enables us to determine positions of the national electricity markets by the level of economic security, as well as to tackle various dangerous phenomena owing to the complex approach to the choice of indicators for evaluation which express the specificity of the energy market under transformation.

The investigation of analytical reports and statistical information has shown that the levels of the economic security of national energy markets vary by features of market functioning. To determine the level of economic security in these countries, twelve indicators (the market share of the largest generator of electricity, the cross-border electricity interconnection, the electricity price volatility, the quality

of electricity supply etc.) have been analysed. The indicators have been grouped into three criteria named „Independence of rivalry”, „Satisfying interests of parties concerned”, and „Transparency of information” according to the established target feature applied according to the grouping.

According to the result of this visualization, it is determined that, in some countries (Germany, Finland, and France), there is the highest level of economic security of the electricity market. Low levels of economic security of the electricity market in Latvia and Croatia are stipulated by recently initiated processes of transformation of the national markets.

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