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ANALYSIS OF SOME IMPORTANT INDICATORS OF THE CROATIAN ELECTRIC POWER DISTRIBUTION SYSTEM

ANALIZA BITNIH POKAZATELJA STANJA DISTRIBUCIJSKOG SUSTAVA U OKVIRU HRVATSKOG ELEKTROENERGETSKOG SUSTAVA

ABSTRACT

The competitiveness of market participants in the European single electricity market depends on the costs of generation, transmission and distribution of electricity. Achieving distributed power generation is an important goal because the generation facilities are located near the final customers, whereby the losses of electricity in the network as well as the need for the capacity of the high voltage network are reduced.

The distribution of electricity in the Republic of Croatia is carried out by the HEP Distribution System Operator (HEP ODS) that manages the distribution network and facilities, as opposed to the energy activity of the distribution of natural gas that is carried out by dozens of operators in their distribution areas. Therefore, the amounts of tariff items in the Tariff system for electricity distribution, for certain categories of customers (i.e. tariff models), are unique over the entire territory of Croatia.

HEP ODS carries out the distribution of electricity in 21 distribution areas, which differ significantly in size, number of employees, number of customers, network length and the amount of distributed electricity. The indicators essential for the efficiency of the distribution system are analyzed in this paper, based on the modified regionalisation of distribution areas.

The aim of this paper is to analyze relevant data for HEP ODS and to compare these data according to the distribution areas, towards the higher efficiency of the system itself.

Key words*: *distribution of electricity, distribution system, regionalisation, efficiency

SAŽETAK

Konkurentnost sudionika na jedinstvenom tržištu električne energije Europske unije (EU) ovisi o troškovima proizvodnje, prijenosa i distribucije električne energije. Distribuirana proizvodnja električne energije, kod koje su proizvodna postrojenja smještena u blizini potrošača, predstavlja dobro rješenje, budući da se smanjuju gubici prijenosa i potreba za prijenosnim kapacitetima visokog napona.

Energetska djelatnost distribucije električne energije u Republici Hrvatskoj obavlja se korištenjem distribucijske mreže i postrojenja od strane HEP Operatora distribucijskog sustava (HEP ODS), za razliku od energetske djelatnosti distribucije prirodnog plina koju na svojim distribucijskim područjima obavlja više desetaka operatora. Stoga su visine tarifnih stavki u Tarifnom sustavu za distribuciju električne energije, za određene kategorije kupaca, odnosno tarifne modele, jedinstvene na području Republike Hrvatske.

HEP ODS obavlja djelatnost distribucije električne energije u svojim distribucijskim područjima, koja se značajno razlikuju po veličini, broju zaposlenih, broju kupaca, duljini mreže i količini distribuirane energije. U ovom su radu analizirani pokazatelji bitni za učinkovitost distribucijskog sustava, na temelju modificirane regionalizacije distribucijskih područja.
Cilj ovog istraživanja je istražiti relevantne podatke za HEP ODS kao cjelinu te ih usporediti po distribucijskim područjima, a u svrhu povećanja učinkovitosti samog sustava.

Ključne riječi: *distribucija električne energije, distribucijski sustav, regionalizacija, učinkovitost*

1. Introduction

Liberalization of the electricity sector has taken place in the EU on the basis of the Directive 96/92/EC on common rules for the internal market in electricity (1996), the Second Energy Package adopted in 2003 and the Third Energy Package adopted in 2009. Full implementation of the Third Energy Package is essential for the successful completion of the Internal Energy Market. As a result of the implementation of the aforementioned energy legislation in the Member States, electricity generation and electricity supply have been carried out as market activities. On the other hand, transmission and distribution of electricity remained regulated because network activities are considered as a typical natural monopoly.
The regulation of distribution of electricity is carried out in such a way that the network operator gets a sufficient income for the operation, development and maintenance of the distribution system with an adequate rate of return on its own investment. In general, national regulatory authorities (NRAs) approve the amount of tariff items that enable financing of the network operators. In electricity distribution, higher tariff items increase the cost of electricity to end customers. Moreover, if a manufacturing company has a high share of the cost of electricity in the final price of the product, electricity price can significantly affect its competitiveness or cause the relocation of manufacturing plants to the area with lower electricity prices.
Banovac *et al.* (2009, 2013) described the complex role of national regulatory authorities, especially related to the regulation of network energy activities. Furthermore, Banovac *et al.* (2005, 2006) conducted an analysis of the elements that are important for electricity market's efficiency and discussed implementation of distributed electricity generation with respect to regulatory issues.
In general, benchmarking is a valuable method of comparing the business process of a company to best practices from companies in the same branch of industry. Benchmarking is the most convenient method to define efficiency of the network energy activities. If regulators use international benchmarking studies, they need to agree upon procedures for data collection, standard templates and data standardization. Furthermore, the target benchmarking design depends primarily on types of utilities. Jamasb and Pollitt (2002) accentuated, in their international benchmarking study related to European electricity distribution companies, that "national energy regulators are looking for international benchmarking analyses for help in setting price controls within incentive regulation". This worthwhile study is based on data on 63 electricity distribution and regional transmission utilities in 6 European countries (Italy, Netherlands, Norway, Portugal, Spain and the United Kingdom). A more detailed overview of benchmarking is interesting, but overpasses the framework of this work. For a more detailed consideration of benchmarking, the works of Jamasb and Pollitt (2000) and Stapenhurst (2009) could be recommended.
There is only one distribution system operator (HEP ODS) in electricity distribution in Croatia. Therefore, it is not possible to use benchmarking in order to compare it with similar operators at a national level or to determine the acceptable costs of electricity distribution. Furthermore, the unique tariff item for energy activity of electricity distribution is set just due to the fact that there is only one distribution system operator, although the investment costs vary (depending on the place of investment). It should be noted that there is a big difference between electricity distribution and gas distribution in Croatia, because 35 operators carry out the energy activity of gas distribution,

and the amount of tariff items for gas distribution is lower in the continental part of the Croatia than in the Adriatic part.
In general, each development investment must be profitable. Some competitive areas may become noncompetitive due to economically unprofitable investments. Therefore, without analyzing a very complex investment problematic henceforward, it should be noted that the impossibility of an investment return in an area, in which some amount of capital is invested, may jeopardize the investor's business. Surely, it is possible that an area is subsidized albeit more cost-effective solutions for this area exist. It is necessary to create a stimulating environment for innovative solutions in order to achieve the competitiveness of non-competitive areas.
Furthermore, the district heating infrastructure will likely not be built in some areas of Adriatic Croatia due to high investment costs, but electricity will be used for heating. Consequently, electric infrastructure could be better used and large seasonal fluctuations in electricity consumption could be avoided (Pudić et al., 2009).
Investments are essential for any business, from the standpoint of economy, realization of preconditions for quality of services, long-term companies' competitiveness, sustainability of energy systems, etc. A highly efficient distribution system may result in lower costs and profitable investments. In the case of the energy activity of distribution of electricity, which represents the distribution of electricity through the distribution networks of different voltage levels for its delivery to customers (excluding supply), lack of quality indicators could result in questionable investment decisions, which could affect the amounts of tariff items. Hence, an analysis of a set of indicators significant for HEP ODS will be conducted in this paper.
HEP ODS is organized into 21 distribution areas, mostly following the principle of the constitution of counties. These organizational units vary in size several times. Therefore, there is a possibility to achieve better efficiency of HEP ODS by implementing consolidation of distribution areas. Better efficiency of the distribution system could affect the electricity price favorably and, consequently, the phenomenon of energy poverty, which is researched by Pudić et al. (2014). The data relevant to the level of HEP ODS are explored in the remainder of this paper. These data are compared by the distribution and regional levels in order to create prerequisites for increasing the efficiency of the observed distribution system.

2. A comparison of DSOs in the countries of the central part of South East Europe

The distribution system operator (DSO) is the subject that controls, monitors and maintains the electricity distribution network that carries electricity from the transmission system to individual consumers. The following data relevant to the efficiency of DSOs will be considered in this paper:

- number of metering points,
- consumption of electricity,
- length of the distribution network,
- number of employees,
- losses in the distribution network.

The situation analysis of the electric power distribution systems in the central part of South East Europe (Albania, Bosnia and Hercegovina, Croatia, Kosovo, Macedonia and Serbia) is conducted in this section. These countries have one DSO, with the exception of Bosnia and Herzegovina that has four. The electric power distribution system is operated by the Croatian distribution system operator (HEP ODS) in Croatia, the Serbian distribution system operator (EPS) in Serbia, the Macedonian distribution system operator (EVNM) in Macedonia, the Albanian distribution system operator (OSHEE) in Albania, the Kosovo distribution system operator (KEDS) in Kosovo, and by four distribution system operators (EPBiH, EPHZHB, ERS and EDB) in Bosnia and Herzegovina. DSOs are state owned in Bosnia and Hercegovina, Croatia and Serbia, while DSOs in Albania, Macedonia and Kosovo are predominantly privately owned.
Basic data on DSOs for the countries of the central part of South East Europe (SEE) are given in Table 1.

Table 1 *Basic data on DSOs in the countries of the central part of SEE (2012)*

Basic data on distribution system	**OSHEE (Albania)**	**EDB (BiH)**	**EPBIH (BiH)**	**EPHZHB (BiH)**	**ERS (BiH)**	**EPS (Serbia)**	**EVNM (Macedonia)**	**HEP ODS (Croatia)**	**KEDS (Kosovo)**
Number of metering points	**1,181,950**	**35,970**	**715,411**	**188,918**	**540,615**	**3,554,417**	**827,366**	**2,350,885**	**483,251**
Electricity delivered to final customers [MWh]	**4,318,583**	**224,456**	**3,933,902**	**1,181,143**	**3,124,475**	**27,839,979**	**5,252,288**	**14,753,134**	**3,468,238**
Supply area size [km²]	**28,748**	**493**	**17,657**	**11,000**	**24,067**	**77,696**	**25,713**	**56,594**	**10,907**
Total length of distribution network [km]	**45,270**	**2,072**	**34,294**	**12,270**	**46,319**	**153,963**	**19,462**	**105,094**	**19,453**
Distribution network average age [yrs]	**37**	**20**	**24**	**24**	**23**	**33**	**-**	**17**	**18**
Number of employees	**4,123**	**112**	**2,756**	**914**	**3,789**	**10,692**	**2,215**	**9,052**	**3,161**
Total losses in distribution network [%]	**44.96**	**14.2**	**9.36**	**14.01**	**14.87**	**14.14**	**17.41**	**8.68**	**33.52**

Data source: South East European DSOs Benchmarking Study (the table is made by the authors).

Table 1 shows that Serbian EPS delivers the greatest amount of electricity to final customers (43% of total electricity delivered in the region). The second is Croatian HEP ODS, which delivers 23%. EDB in Brčko District in Bosnia and Herzegovina delivers the smallest amount of electricity to final customers (0.35%). Serbian EPS also has the highest values of almost all basic data – 3,554,417 metering points and supply area size of 77,696 km^2. The table also shows that the total losses in the distribution network are the highest in Albania and Kosovo with a huge 44.96% and 33.52%, then in Macedonia with 17.41%. It seems amazing that DSOs with the highest losses are mostly privately owned. In general, if losses are included in the approved costs, there is a possibility that a private owner allows illegal electricity consumption for certain customers.

Croatian HEP ODS has the smallest total losses in the distribution network. The number of employees is the largest in DSOs in Serbia and Croatia. By comparing these DSOs, it can be concluded that although the amount of electricity delivered to final customers in Serbia is almost doubled, and the total length of the distribution network is almost 50% higher, the number of employees in Croatia is only 15% smaller. The distribution network average age amounts from 17 years in Croatia up to 33 years in Serbia. By analyzing the presented data, it can be concluded that the network age and losses in the distribution network are not directly correlated.

Important indicators for DSOs in the countries of the central part of SEE are shown in Table 2.

Table 2 *Important indicators for DSOs in the countries of the central part of SEE (2012)*

Important benchmarking indicators	**OSHEE (Albania)**	**EDB (BiH)**	**EPBIH (BiH)**	**EPHZHB (BiH)**	**ERS (BiH)**	**EPS (Serbia)**	**EVNM (Macedonia)**	**HEP ODS (Croatia)**	**KEDS (Kosovo)**
Electricity delivered per metering point [KWh]	**3,654**	**6,240**	**5,499**	**6,252**	**5,779**	**7,833**	**6,348**	**6,276**	**7,177**
Electricity delivered per distribution network length [MWh/km]	**95**	**108**	**115**	**96**	**67**	**181**	**270**	**140**	**178**
Number of metering points per 1 km of network length	**26.11**	**17.36**	**20.86**	**15.40**	**11.67**	**23.09**	**42.51**	**22.37**	**24.84**
Length of distribution network per employee [km/employee]	**10.98**	**18.50**	**12.44**	**13.42**	**12.22**	**14.40**	**8.79**	**11.61**	**6.15**
Number of metering points per employee	**286.67**	**321.16**	**259.58**	**206.69**	**142.68**	**332.44**	**373.53**	**259.71**	**152.88**
Electricity delivered per employee [MWh/employee]	**1,047**	**2,004**	**1,427**	**1,292**	**825**	**2,604**	**2,371**	**1,630**	**1,097**

Source: The table is made by the authors.

The amount of electricity delivered per metering point is the lowest in Albania (3,654 kWh), which may indicate that the industrial consumption is much lower than in other considered countries, assuming that the average household spends 2,000 □ 3,000 kWh.
The maximum electricity delivered per metering point is in Serbia (7,833 kWh). The highest amount of electricity delivered per kilometer of the distribution network is in Macedonia (270 MWh/km). This amount is almost two times lower in Croatia (140 MWh/km), while some DSOs in Bosnia and Herzegovina have few times lower amount of electricity delivered per kilometer of the distribution network than Macedonia, which is also an indicator of the competitiveness of the electricity distribution system in Macedonia.
The next important indicator is the number of metering points per kilometer of the distribution network. This indicator shows that the highest density of connections is in Macedonia (42.51), while this density is almost twice as small in most electricity distribution systems, and even three to four times smaller in some electricity distribution systems.
Concerning the indicator that shows the length of electricity distribution network per employee, it is obvious that KEDS (Kosovo) with 6.15 km/employee is the last in this category. Furthermore, one employee covers only 8.79 km of the electricity distribution network in the case of EVNM (Macedonia). EDB has the best ratio of km/employee (18.50) although the Brčko District in Bosnia and Herzegovina is the smallest distribution area.
In Macedonia, one employee covers the most metering points (373.53). On the contrary, one employee covers only 152.88 metering points in the case of KEDS in Kosovo, and 142.68 in the case of ERS in Bosnia and Herzegovina.
According to the SEE DSOs Benchmarking Study (2015), the SEE DSOs are less efficient per employee, compared to 7 subsidiaries of the American Electric Power (AEP), which is an important electric utility in the United States. US companies have a much larger level of electricity delivered per employee (22 □ 35 GWh/employee) than SEE DSOs (even the best EPS has only 2.6 GWh/employee). Furthermore, AEP companies have the average ratio of electricity delivered per distribution network length of 480 MWh/km. Consequently, the distribution network infrastructure is more efficiently used in given AEP companies than in SEE DSOs.

3. The operator of the electricity distribution system in Croatia

The Croatian electricity distribution system operator HEP ODS had 9,052 employees in 2012. The total number of measurement points was 2,350,885. The supply area size was 56,594 square kilometers. HEP ODS comprises 21 distribution areas that vary in size and values of indicators. Due to large differences between these areas, a potential restructuring with the aim of decreasing the number of distribution areas could be opened for analysis. Basic data on the HEP ODS' distribution areas (number of employees, number of metering points, electricity delivered to final customers, length of the distribution network, supply area size and losses in distribution network) are shown in Table 3.
Observing the data shown in Table 3, it is obvious that the distribution areas vary up to 10 times by the number of employees, and up to 20 times by the criteria of the number of metering points and the electricity delivered to final customers. HEP ODS has 56 workers at the company's headquarters in Zagreb. Split and Zagreb are distribution units with over 1,000 employees and over 15,000 kilometers of distribution network. Four distribution units have over 1 million MWh of electricity delivered to final customers.
The values of important indicators, for the distribution areas of HEP ODS, are shown in table 4. The indicators are:

- electricity delivered per metering point,
- electricity delivered per distribution network length,
- electricity delivered per employee,
- number of metering points per kilometer of network length,
- length of distribution network per employee,
- number of metering points per employee.

Table 3 *Basic data on HEP-ODS' distribution areas (2012)*

Distribution area	Number of employees	Number of metering points	Electricity delivered to final custumers [MWh]	Total length of distribution network [km]	Supply area size [km²]	Total losses in distribution network (%)
Zagreb	1,343	542,013	3,761,667	17,419	2,550	7.95
Zabok	305	66,635	416,449	5,475	1,235	10.07
Varaždin	293	70,023	480,111	5,491	1,003	6.58
Čakovec	172	46,133	318,502	2,974	730	5.74
Koprivnica	239	52,671	314,761	4,754	1,645	5.11
Bjelovar	243	51,103	286,782	3,899	1,789	6.95
Križ	358	77,811	426,853	5,706	3,992	7.28
Osijek	732	153,776	929,046	7,580	4,152	10.32
Vinkovci	298	81,890	467,990	4,293	2,448	8.82
Slavonski Brod	261	64,696	354,232	3,345	1,983	8.40
Pula	562	150,817	1,104,314	7,778	2,813	6.36
Rijeka	728	208,588	1,398,758	9,959	3,574	8.08
Split	1,174	281,093	1,773,227	16,414	5,030	10.88
Zadar	401	117,012	664,509	8,071	2,693	9.58
Šibenik	389	85,030	414,197	7,078	3,031	10.84
Dubrovnik	223	52,457	413,294	4,379	1,434	13.55
Karlovac	382	86,990	479,070	5,935	4,300	10.82
Sisak	346	57,871	328,910	6,040	3,204	6.80
Gospić	264	46,897	193,289	5,676	6,408	12.34
Virovitica	135	30,219	159,127	2,421	1,431	5.39
Požega	148	27,160	165,744	1,940	1,251	6.91

Data source: Annual Report of HEP ODS in 2012 (the table is made by the authors).

Table 4 *Values of important indicators for HEP-ODS' distribution areas (2012)*

Distribution area	Electricity delivered per metering point [kWh]	Electricity delivered per distribution network length [MWh/km]	Electricity delivered per employee [MWh/employee]	Number of metering points per 1 km of network length	Length of distribution network per employee [km/employee]	Number of metering points per employee
Zagreb	6,940	215.95	2,801	31.12	12.97	403.58
Zabok	6,250	76.06	1,365	12.17	17.95	218.48
Varaždin	6,856	87.44	1,639	12.75	18.74	238.99
Čakovec	6,904	107.10	1,852	15.51	17.29	268.22
Koprivnica	5,976	66.21	1,317	11.08	19.89	220.38
Bjelovar	5,612	73.55	1,180	13.11	16.05	210.30
Križ	5,486	74.81	1,192	13.64	15.94	217.35
Osijek	6,042	122.57	1,269	20.29	10.36	210.08
Vinkovci	5,715	109.01	1,570	19.08	14.41	274.80
Slavonski Brod	5,475	105.90	1,357	19.34	12.82	247.88
Pula	7,322	141.98	1,965	19.39	13.84	268.36
Rijeka	6,706	140.45	1,921	20.94	13.68	286.52
Split	6,308	108.03	1,510	17.13	13.98	239.43
Zadar	5,679	82.33	1,657	14.50	20.13	291.80
Šibenik	4,871	58.52	1,065	12.01	18.20	218.59
Dubrovnik	7,879	94.38	1,853	11.98	19.64	235.23
Karlovac	5,507	80.72	1,254	14.66	15.54	227.72
Sisak	5,684	54.46	951	9.58	17.46	167.26
Gospić	4,122	34.05	732	8.26	21.50	177.64
Virovitica	5,266	65.73	1,179	12.48	17.93	223.84
Požega	6,103	85.44	1,120	14.00	13.11	183.51

Source: The table is made by the authors.

Based on the data shown in Table 4, it can be concluded that the distribution area of Zagreb has the best indicators except for electricity delivered per metering point because the distribution areas of Dubrovnik and Pula delivered more electricity per metering point. The distribution area of Gospić has the lowest amount of electricity delivered per distribution network length (it is almost two times less than the first that follows). The distribution area of Zagreb has the highest amount of electricity delivered to final customers, the highest amount of electricity delivered per distribution network length, the highest amount of electricity delivered per employee, the highest number of metering points per kilometer of network length and the highest number of metering points per employee.
Considering large differences between the distribution areas of HEP ODS, an option of its reorganization in the distribution system operator with larger (regional) distribution areas could be researched, just as an opportunity for achieving higher efficiency. The effects of the hypothetically reorganized HEP ODS, based on the model of the organization with six regional distribution areas chosen by the authors, are presented in the continuation of this paper. The values of basic data on such hypothetically reorganized HEP ODS are calculated by the authors (Table 5).

Table 5 *Basic data on the hypothetical HEP ODS, which is reorganized based on the principle of regionalisation*

	Number of employees	Number of metering points	Electricity delivered to final custumers (MWh)	Total length of distribution network (km)	Supply area size (km²)	Total losses in distribution network (%)
DA-1 (Zagreb)	**1,343**	**542,013**	**3,761,667**	**17,419**	**2,550**	**7.95**
Zabok	305	66,635	416,449	5,475	1,235	10.07
Varaždin	293	70,023	480,111	5,491	1,003	6.58
Čakovec	172	46,133	318,502	2,974	730	5.74
Koprivnica	239	52,671	314,761	4,754	1,645	5.11
Bjelovar	243	51,103	286,782	3,899	1,789	6.95
DA-2	**1,252**	**286,565**	**1,816,605**	**22,593**	**6,402**	**6.89**
Osijek	732	153,776	929,046	7,580	4,152	10.32
Vinkovci	298	81,890	467,990	4,293	2,448	8.82
Slavonski Brod	261	64,696	354,232	3,345	1,983	8.40
Virovitica	135	30,219	159,127	2,421	1,431	5.39
Požega	148	27,160	165,744	1,940	1,251	6.91
DA-3	**1,574**	**357,741**	**2,076,139**	**19,579**	**11,265**	**7.97**
Pula	562	150,817	1,104,314	7,778	2,813	6.36
Rijeka	728	208,588	1,398,758	9,959	3,574	8.08
Gospić	264	46,897	193,289	5,676	6,408	12.34
Zadar	401	117,012	664,509	8,071	2,693	9.58
DA-4	**1,955**	**523,314**	**3,360,870**	**31,484**	**15,488**	**9.09**
Split	1,174	281,093	1,773,227	16,414	5,030	10.88
Šibenik	389	85,030	414,197	7,078	3,031	10.84
Dubrovnik	223	52,457	413,294	4,379	1,434	13.55
DA-5	**1,786**	**418,580**	**2,600,718**	**27,871**	**9,495**	**11.76**
Karlovac	382	86,990	479,070	5,935	4,300	10.82
Sisak	346	57,871	328,910	6,040	3,204	6.80
Križ	358	77,811	426,853	5,706	3,992	7.28
DA-6	**1,086**	**222,672**	**1,234,833**	**17,681**	**11,496**	**8.30**

Data source: The table is made by the authors.
Note: DA - Distribution Area

The calculated values of important indicators (ratios), for the considered model with larger regional distribution areas, are presented in Table 6.
Analysis of the data presented in tables 5 and 6 shows that the concentrated distribution areas no longer differ 10 □ 20 times, but only up to three times. According to the considered model, the number of employees would be in the range of 1.086 (DA-6) to 1.955 (DA-4). The number of metering points would be over 200,000 and the distribution network length would be over 17,000

km in all DAs. The distribution areas organized according to the considered principle would have a real possibility to reduce the fixed costs and to increase efficiency.

Table 6 *Values of important indicators of the reorganized distribution areas, based on the principle of regionalisation*

Distribution area	Electricity delivered per metering point (kWh)	Electricity delivered per distribution network length (MWh/km)	Electricity delivered per employee (MWh/employee)	Number of metering points per 1 km of network length	Length of distribution network per employee (km/employee)	Number of metering points per employee
DA-1	6,940	215.95	2,801	31.12	12.97	403.58
DA-2	6,339	80.41	1,451	12.68	18.05	228.89
DA-3	5,803	106.04	1,319	18.27	12.44	227.28
DA-4	6,422	106.75	1,719	16.62	16.10	267.68
DA-5	6,213	93.31	1,456	15.02	15.61	234.37
DA-6	5,546	69.84	1,137	12.59	16.28	205.04

Data source: The table is made by the authors.

Note: DA - Distribution Area

4. Conclusion

Analysis of the values of the chosen basic data (consumption of electricity, the length of the distribution network, the total number of measurement points, number of employees, the losses in the distribution system) and of the selected relevant indicators (electricity delivered per metering point, electricity delivered per distribution network length, electricity delivered per employee, number of metering points per kilometer of network length, length of distribution network per employee and number of metering points per employee), which is conducted for the current organization of the HEP ODS (21 distribution areas) and for the hypothetically reorganized HEP ODS, based on the model of six regional distribution areas chosen by the authors, showed a significant equalization of such hypothetically reorganized regional distribution areas, according to the criteria of number of employees, number of metering points and the length of the distribution network. Consequently, there are possibilities for reducing fixed costs and increasing the efficiency of the electric power distribution system organized in larger distribution areas.

The rationalization of the distribution system of HEP ODS, along with the possibilities reviewed in this paper, would also include a broader analysis of operating costs, optimization of the number of employees, technical losses in the network, etc. In this context, there is a clear need for further researches.

Finally, we want to emphasize that, in the scenario in which more DSOs compete in a larger electricity market, the higher efficiency of a certain DSO should be manifested in the reduction of costs, which will represent its significant competitiveness if it will sell electricity to customers using the principle of market prices.

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