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A review of the 2018 Polish capacity market auctions

ABSTRACT: The paper investigates the supply structure of the capacity market in Poland in the coming years. The results of the capacity auctions conducted in 2018 are analyzed for this purpose. Three auctions were held at that time. The products traded in the capacity market are capacity obligations for the following years: 2021, 2022 and 2023. The auctions were organized in accordance with (i) the Act of December 8, 2017 on the Capacity Market and the (ii) Capacity Market Regulations published by the Polish Power Grid. The source of data used in this study is the official information of the President of the Energy Regulatory Office on the final results of the main auctions for 2021–2023 delivery periods. The list of the capacity suppliers who won capacity auctions contains the type of capacity market units, the volume of capacity obligations, the duration of capacity agreements and the business name of the capacity suppliers. The conducted analysis indicates that the auction for 2021 was won mainly by existing units (45.81%) and refurbishing units (33.51%). In subsequent years, the share of existing generating units is significantly higher and amounts to 91.67% for 2022 and 84.54% for 2023. The results of the study carried out in this paper also show that one energy company, being the owner of power generating daughter companies, has a very high share in these capacity auctions. The PGE Capital Group contracted 51.95% for 2021, 69.92% for 2022 and 64.44% for 2023 of the total capacity obligation. The volume amounts to over 70% of their total installed capacity.

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The obtained results allow one to determine the supply structure of the capacity market in Poland in 2021–2023. The outcomes of this paper also provide input data for further research on the modeling of the Polish energy sector.

KEYWORDS: capacity market, capacity auction, capacity remuneration mechanisms, market design

1. Introduction and policy context

The wholesale electricity market failures are widely discussed in the international literature (Bowring 2013; Cramton et al. 2013; Davis et al. 2013; Mastropietro et al. 2018). Firstly, electricity demand is very price inelastic in the short run. Consumers, mainly households, do not respond to hourly price fluctuations in the wholesale electricity market. Secondly, the problem of balancing the power system with the increasing share of renewable energy sources is observed (IRENA 2018). This phenomenon is crucial due to the intermittent nature of wind and solar energy technology and their very low marginal costs. Consequently, during favorable weather conditions periods, conventional generation units are forced to sell electricity at prices that do not cover their costs. Thirdly, there are electricity price caps set below market prices, also during peak demand periods. This results in the *missing money* problem of the existing power generation units (Cramton and Stoft 2006; Joskow 2008). As mentioned above, the energy-only market is not capable of providing adequate incentives for investors to refurbish the existing units or build new ones. The lack of incentives for investors result in the decrease in installed capacity, hence it will not be possible to meet the demand for electricity in the peaking hours in the long-term. This problem is called the *resource adequacy problem* or the *missing capacity* (Cramton and Stoft 2006).

The capacity remuneration mechanisms (CRMs) seem to be a solution to the resource adequacy problem which has emerged in liberalized electricity markets not only in Europe but also worldwide. Existing CRMs can be classified into two main groups (ACER 2013): (i) price-based and (ii) volume-based mechanisms. In the first one, the Transmission System Operator (TSO) or Regulator is obligated to determine the price for available capacity in the delivery periods. When investors know the price, they can assess the profitability of the refurbishment or construction of new power generation units. The price-based mechanisms constitute direct financial support for investors (KU Leuven Energy Institute 2013). The capacity payment is one of them. In the case of volume-based mechanisms, the TSO or Regulator determines the amount of capacity which is essential to meet the demand in the delivery period. This amount is determined based on the forecasted demand and the required level of reserves over the forecasted demand. The volume-based mechanisms are then grouped in (i) market-wide and (ii) targeted mechanisms. The main difference between them is the method of price formation. While the first one is based on market principles, the latter is based on contractual agreements. The classification of capacity remuneration mechanisms is presented in Table 1.

TABLE 1. Classification of the Capacity Remuneration Mechanisms

TABELA 1. Klasyfikacja mechanizmów wynagradzania zdolności wytwórczych

Capacity Remuneration Mechanisms				
Volume-based				Price-based
Targeted	Market-wide			
Strategic Reserve	Capacity Market	Capacity Obligation	Reliability Option	Capacity Payment

Source: own study based on (ACER 2013).

2. Capacity market in Poland

The capacity remuneration mechanism introduced in Poland is a capacity market, one of the volume-based mechanisms. The mechanism was implemented by the Act of December 8, 2017 on the Capacity Market (Dz.U. 2018 poz. 9). The concept of this regulation is based on the capacity market developed in the United Kingdom (Benalcazar and Nalepka (2017) compared the Polish and British capacity markets). The main aim of the implementation of this mechanism is to ensure sufficient capacity in the power generation system in the long-run. The challenges in Polish power generation system were presented in (Szmitkowski et al. 2016; Benalcazar and Kamiński 2016).

The participants of the capacity market and the key relations between them are shown in Figure 1. The regulatory body is the Transmission System Operator – the Polish Power Grid Company (Polskie Sieci Elektroenergetyczne SA, PSE SA). Among other responsibilities, the TSO carries out the following activities: (i) general certification of the existing generation units, (ii) certification to main and supplementary auctions, (iii) determination of capacity demand in delivery periods, (iv) management of main and supplementary auctions, and (v) control of capacity agreements. The capacity market units (existing and new generation units, DSR units, energy storage etc.) participate in the capacity auction – if they win, they are obliged to provide capacity in the delivery period. The revenue from the capacity market is the market clearing price multiplied by the declared capacity obligation.

The capacity auction is organized as a descending clock auction (the Dutch auction). The auction starts at a high price, which is gradually reduced by a certain rate (Carare and Rothkopf 2005). Each capacity market unit (CMU) offers the volume of capacity at a price that is equal to: (i) the starting price of the next round, (ii) the exit price (if the exit offer is submitted) or (iii) a minimum price equals 0.01/kW/month (if the exit offer is not submitted in the last round). This solution is called a *pay-as-clear* auction. Saługa and Kamiński (2017) investigated that the market clearing price set in the *pay-as-clear* system is lower than the price set in the

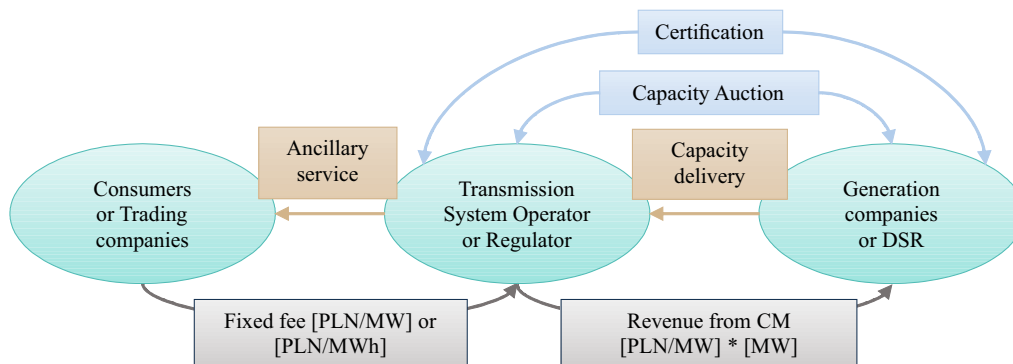


Fig. 1. The model of centralized capacity market

Source: own study based on (De Wachter and Buijs 2012; Zamasz 2015)

Rys. 1. Model zcentralizowanego rynku mocy

pay-as-bid system. The CMUs which won the capacity auction sign the agreements with the TSO. The cost of the capacity market is covered by consumers.

3. Data and methodology

This study analyses the results of the three main auctions organized in 2018. The analysis is based mainly on official datasets published by the President of the Energy Regulatory Office. They contain the list of the capacity market units which won these auctions. The products traded in the auction conducted in 2018 are the capacity obligation for the delivery periods of (i) 2021, (ii) 2022 and (iii) 2023. The list of capacity suppliers who won the main auctions includes the following specification:

- ◆ code of the capacity market units (e.g. JRM/58, JRM/231, JRM/303),
- ◆ type of capacity market units (e.g. existing generation unit, refurbishing generation unit, new generation unit, unconfirmed demand side response unit),
- ◆ volume of the capacity obligation [MW],
- ◆ duration of the capacity obligation [years],
- ◆ the name and the tax number of the capacity supplier.

Moreover, data published by key power generation companies that include the volume of total installed capacity are used mainly for: the PGE Capital Group, the ENEA Capital Group, and the TAURON Capital Group.

The shares of each type of capacity market units are calculated. Firstly, the results are analyzed individually for each year. Secondly, an analysis of the cumulative outcomes for 2022 and

2023 delivery periods is carried out. In the next step, the share of each company (individually for each year and cumulatively for 2022 and 2023) is discussed. The results are then compared to the total installed capacity of the generations companies.

4. Result and discussion

The volume of total capacity obligation for 2021, 2022 and 2023 amount to 22,732 MW, 23,003 MW and 23,292 MW (Dz.U. 2018 poz. 1632).

A summary of the main auctions conducted in 2018 is presented in Table 2. The auction for the delivery period of 2021 cleared at 240.32 PLN/kW/year, which was the highest price of the three auctions. The total volumes of capacity obligations for all delivery periods only slightly exceed the level of capacity that TSO planned to purchase.

TABLE 2. The final results of the main auctions conducted in 2018

TABELA 2. Wyniki aukcji głównych przeprowadzonych w 2018 roku

		2021	2022	2023
Auction clearing price	PLN/kW/year	240.32	198.00	202.99
Total volume of capacity obligations for each delivery period (calculated on the basis of the capacity agreements for the delivery period for which the main auction was conducted)	MW	22,427.066	10,580.56	10,631.191
Total volume of the capacity obligation for each delivery period increased by the volume from the capacity agreements for each year signed in previous main auctions	MW	22,427.066	23,038.875	23,215.010
Number of closing round	–	5	7	8
Number of offers that won auctions	–	160	120	94

Source: own study based on (URE 2018a; 2018b; 2019).

The main auction for the 2021 delivery period was won mainly by existing and refurbishing generation units (Fig. 2). The owners of 84 existing units signed the agreements for 10,274.05 MW, which is 45.81% of the total volume of capacity obligations. The 47 companies with refurbishing generation units contracted 7,516.15 MW, which is 33.51% of the total capacity obligation. Approximately 17.93% (4,022.27 MW) constitutes new generation units. The number of planned investment projects is 11. Demand side response units represent the smaller

share in these results. These units constitute only 2.74% (614.60 MW) of the total capacity contracted in this auction. The auction was won by 18 DSR units.

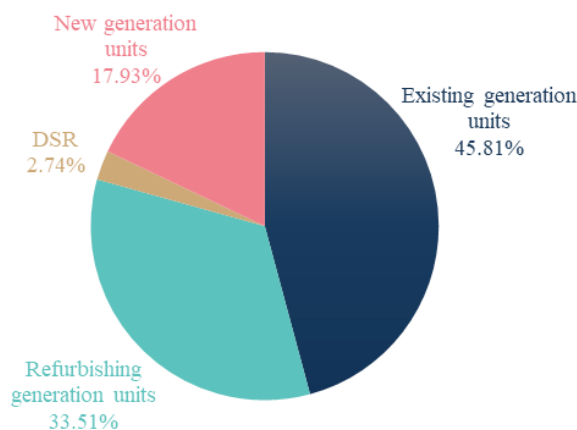


Fig. 2. The types of capacity market units for the 2021 delivery period
Source: own study

Rys. 2. Jednostki rynku mocy, które wygrały aukcję główną na rok dostaw 2021

The main auction for the 2022 delivery period was won almost entirely by existing generation units (Fig. 3). 98 existing power generation units accounted for 91.67% of the total capacity obligation. They offered the volume of capacity of 9,699.06 MW. The demand side response units constitute 7.19% (761 MW). The auction was won by 21 DSR units. Only one refurbishing generation unit (120 MW) signed a capacity agreement in the auction for 2022.

Figure 4 presents the types of capacity market units which will perform capacity obligations in the 2022 delivery period. There are (i) units which won the main auction for 2022 and signed the capacity agreement for at least one year and (ii) units which won the main auction for 2021 and signed the capacity agreement for at least two years. The distribution of all types of CMUs is very similar to the distribution shown in Figure 1. It means that all of the refurbishing generation units which won the main auction for 2021 signed the capacity agreement for more than a year. The same applies to all new generation units. Among existing power generation units, only one signed the agreement for more than one year (15 years). One of the DSR units also signed the agreement for more than one year (5 years). The cumulative capacity obligation for 2022 is as follows: (i) 10,614.456 MW (46.07%) – existing generation units, (ii) 7,636.15 MW (33.14%) – refurbishing generation units, (iii) 4,022.27 MW (17.46%) – new generation units and (iv) 766 MW (3.32%) – DSR units. The total number of CMUs for 2022 amounts to 180.

The main auction for the 2023 delivery period was won by 94 capacity market units. The largest share constitutes existing generation units (Fig. 5). The owners of 71 existing units signed capacity agreements for the volume that amounts to 8,987.59 MW (84.54% of total volume). The

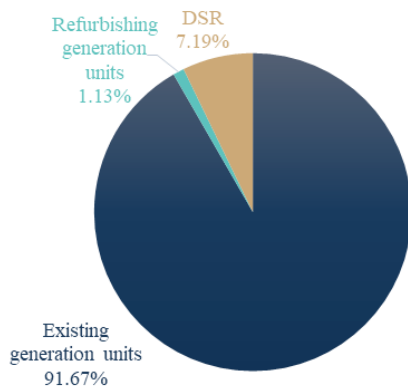


Fig. 3. The types of capacity market units for the 2022 delivery period that won the auction conducted for 2022
Source: own study

Rys. 3. Jednostki rynku mocy, na rok dostaw 2022 roku, które wygrały aukcję główną przeprowadzoną na rok dostaw 2022

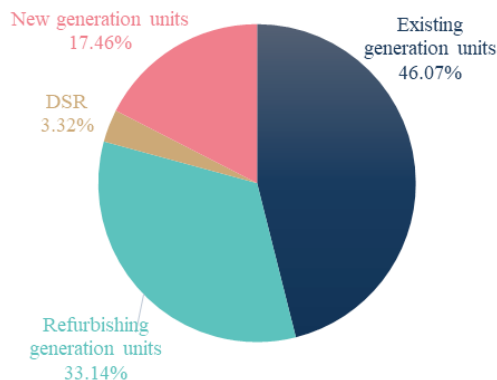


Fig. 4. The types of capacity market units for the 2022 delivery period that won the auctions conducted for 2021 and 2022
Source: own study

Rys. 4. Jednostki rynku mocy na rok dostaw 2022 roku, które wygrały aukcje główne przeprowadzone na lata dostaw 2021 i 2022

auction was also won by 22 DRS units and one new generation unit of 852.6 MW (8.02% of the total volume). The DSR units contracted 797 MW, which is 7.44%.

All of the CMUs which will perform capacity obligations in the 2023 delivery period are presented in Figure 6. There are (i) units which won the main auction for 2023 and signed the capacity agreement for at least one year and (ii) units which won the main auction for 2022 and signed the capacity agreement for at least two years and (iii) units which won the main auction for 2021 and signed the capacity agreement for at least three years. This Figure is also similar to Figure 1. It should be noted that all units which contracted capacity after the auction for 2021 for more than a year, will also perform capacity obligation during the 2023 delivery period. In the auction for 2022, only two units signed capacity agreements for more than two years: a refurbishing generation unit of 120 MW and a DSR unit of 5 MW. The cumulative capacity obligation for 2023 is as follows: (i) 9,902.99 MW (42.66%) – existing generation units, (ii) 7,636.15 MW (32.89%) – refurbishing generation units, (iii) 4,874.87 MW (21.00%) – new generation units and (iv) 801 MW (3.45%) – DSR units. The total number of CMUs for the 2022 delivery period amounts to 156.

The main auction for the 2021 delivery period was won by 39 companies. Some of them operate as part of capital groups (Fig. 7). The PGE Capital Group has the largest share among the units which won this auction. They contracted 11,651.66 MW which is 51.95% of total capacity obligation. 64 capacity market units belong to this Capital Group. The PGE Capital Group consists of the following companies which units won the auction: PGE Energia Ciepła SA, PGE Energia Odnawialna SA, PGE Górnictwo i Energetyka Konwencjonalna SA, and PGE Polska

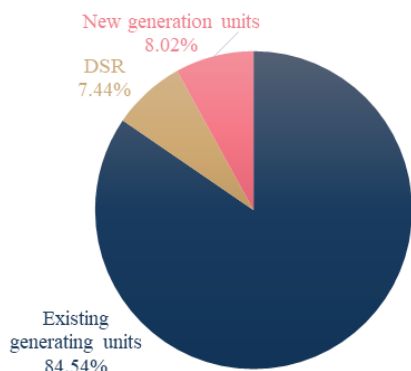


Fig. 5. The types of capacity market units for the 2023 delivery period that won the auction conducted for 2023
Source: own study

Rys. 5. Jednostki rynku mocy na rok dostaw 2023 roku, które wygrały aukcję główną przeprowadzoną na rok dostaw 2023

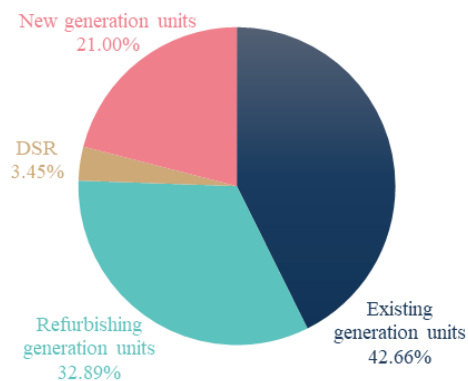


Fig. 6. The types of capacity market units for the 2023 delivery period that won the auction conducted for 2021, 2022 and 2023
Source: own study

Rys. 6. Jednostki rynku mocy na rok dostaw 2023 roku, które wygrały aukcje główne przeprowadzone na lata dostaw 2021, 2022 i 2023

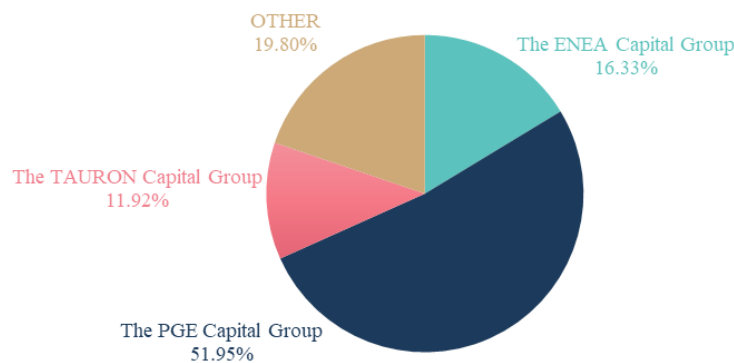


Fig. 7. The capacity suppliers for the 2021 delivery period
Source: own study

Rys. 7. Dostawcy mocy na rok dostaw 2021

Grupa Energetyczna SA. The largest volume of capacity was contracted by the latter two. The ENEA Capital Group will perform capacity obligations of 3,662.96 MW (16.33%) in the 2021 delivery period. ENEA Wytwarzanie Sp. z o.o., and Elektrownia Połaniec SA are the daughter companies of ENEA Capital Group. The total number of units that belong to them amounts to

15. The TAURON Capital Group (which consist of TAURON Polska Energia SA, TAURON Wytwarzanie SA, Nowe Jaworzno Grupa TAURON Sp. z o.o., and TAURON Ciepło SA) contracted 2,672.49 MW, which is 11.92% of total capacity contracted in auction for 2021. They had 18 winning CMUs. The remaining 63 units contracted 4,439.95 MW, which is 19.80% of the total.

The results of the auction for 2022 are presented in Figure 8. In this case, the main winning supplier is also the PGE Capital Group. The 55 CMUs belonging to their companies contracted 7,397.05 MW, which is 69.92% of total contracted capacity. EnerNOC Poland Ltd. signed 14 contracts for 546 MW (5.16%). The TAURON Capital Group will perform capacity obligations in this delivery period which amounts to 422.23 MW (3.99%). The remaining 45 units contracted 2,214.77 MW, which is 20.93% of the total.

All suppliers that won the auctions for the 2022 delivery period are presented in Figure 9. There are (i) companies which won the main auction for 2022 and (ii) companies which won the main auction for 2021 and signed the capacity agreement at least for two years. The share of key companies is very similar to share presented in Figure 7. The cumulative capacity obligation contracted by them for 2022 is as follows: (i) 12,039.76 MW (52.26%) – the PGE Capital Group, (ii) 3,662.96 MW (15.90%) – the ENEA Capital Group, and (iii) 2,668.89 MW (11.58%) – the TAURON Capital Group. The remaining companies signed the agreements for 4,667.26 MW (20.26%).

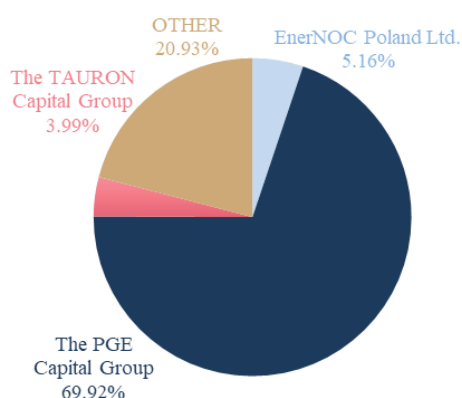


Fig. 8. The capacity suppliers for the 2022 delivery period that won the auction conducted for 2022
Source: own study

Rys. 8. Dostawcy mocy na rok dostaw 2022, którzy wygrali aukcję mocy przeprowadzoną na rok dostaw 2022

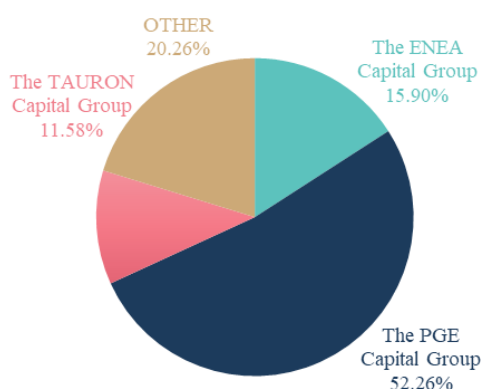


Fig. 9. The capacity suppliers for the 2022 delivery period that won the auction conducted for 2021 and 2022
Source: own study

Rys. 9. Dostawcy mocy na rok dostaw 2022, którzy wygrali aukcję mocy przeprowadzoną na lata dostaw 2021 i 2022

Figure 10 presents the key companies which won the capacity auction for the 2023 delivery period. As previously, the PGE Capital Group also had the largest share. The companies belonging to this Group signed 32 capacity agreements for 6,850.38 MW (64.44%). The Ostrołęka

Power Plant (Elektrownia Ostrołęka SA) won the auction and contracted 852.60 MW (8.02%). The remaining 61 units contracted 2,928.21 MW, which is 27.54% of the total.

The capacity suppliers for the 2023 delivery period that won the auction conducted for 2021, 2022 and 2023 are shown in Figure 11. The share of key Capital Groups is also similar to the share presented in Figure 7. The cumulative capacity obligation contracted by them for 2023 is as follows: (i) 11,493.09 MW (49.51%) – the PGE Capital Group, (ii) 3,662.96 MW (15.78%) – the ENEA Capital Group, and (iii) 2,639.89 MW (11.37%) – the TAURON Capital Group. The remaining companies signed the agreements for 5,419.07 MW (23.34%).

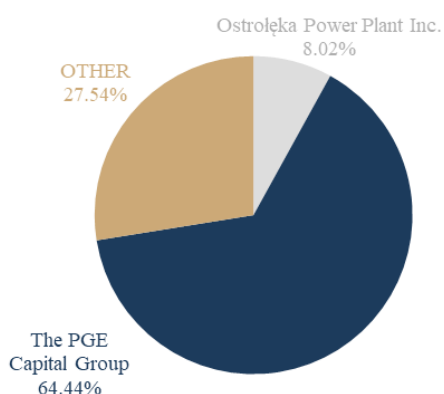


Fig. 10. The capacity suppliers for the 2023 delivery period that won the auction conducted for 2023
Source: own study

Rys. 10. Dostawcy mocy na rok dostaw 2023, którzy wygrali aukcję mocy przeprowadzoną na rok dostaw 2023

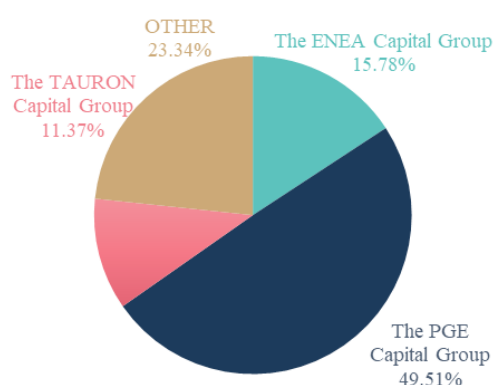


Fig. 11. The capacity suppliers for the 2023 delivery period that won the auction conducted for 2021, 2022 and 2023
Source: own study

Rys. 11. Dostawcy mocy na rok dostaw 2023, którzy wygrali aukcje mocy przeprowadzone na lata dostaw 2021, 2022 i 2023

In a broader perspective, the PGE Capital Group contracted approximately 70% of their total installed capacity for 2021, 2022 and 2023. The ENEA Capital Group signed the agreements for 58.14% of their total capacity for each delivery period. The TAURON Capital Group contracted approximately 50% of the installed capacity for 2021–2023.

Conclusions

The purpose of this study was to determine the supply structure of the capacity market in Poland in the coming years. The results of the capacity auctions conducted for the 2021, 2022 and 2023 delivery periods were analyzed. The auction for 2021 was won mainly by existing

power generation units. The lower share of demand side response units was a result of their interest in other (already existing) support mechanisms that is more attractive for these units. The key capacity suppliers are: the PGE Capital Group, the ENEA Capital Group and the TAURON Capital Group.

In subsequent years, existing generation units have a predominant share over other capacity market units. Nevertheless, all of the refurbishing and new generation units which won the main auction for 2021 signed capacity agreements for more than two years. This is reflected in the structure of total capacity market units that will perform capacity obligations in the 2022 and 2023 delivery period. The PGE Capital Group also won auctions for 2022 and 2023. The share of the ENEA Capital Group and the TAURON Capital Group is similar to the results of the 2021 capacity auction. It should be pointed out that the EnerNOC Poland Ltd., which manages demand side response units, has a significant share in results of the auction for the 2022 delivery period.

Moreover, the outcomes of capacity auctions were compared with installed capacities of the largest energy groups operating in Poland. The highest share of installed capacity was contracted by the PGE Capital Group, approximately 70% for each delivery year. The ENEA Capital Group signed contracts for 58.14% of their installed capacity for 2021, 2022 and 2023. The TAURON Capital Group contracted approximately 50% of its capacity for these years.

The obtained results allow one to determine the supply mix of the power market in 2021–2023. The outcomes also provide input data for further research on the modeling of the Polish power generation sector.

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Analiza wyników aukcji mocy przeprowadzonych w 2018 roku

Streszczenie

Celem niniejszego artykułu jest określenie struktury strony podaźowej rynku mocy w Polsce w nadchodzących latach. Analizie poddano wyniki aukcji mocy przeprowadzonych w 2018 roku. W analizowanym okresie przeprowadzone zostały trzy aukcje mocy, na których przedmiotem wymiany handlowej był obowiązek mocy na następujące lata dostaw: 2021, 2022 oraz 2023. Aukcje zostały przeprowadzone zgodnie z (i) Ustawą o rynku mocy oraz (ii) Regulaminem Rynku Mocy opracowanym przez Polskie Sieci Elektroenergetyczne SA. Dane wykorzystane do przeprowadzania analizy przedstawionej w artykule pochodzą z oficjalnych informacji Prezesa Urzędu Regulacji Energetyki, zawierających ostateczne wyniki aukcji głównej na lata 2021–2023. Przeprowadzona analiza wskazuje, że aukcję na 2021 rok wygrały głównie istniejące jednostki rynku mocy (45,81%) oraz jednostki modernizowane (33,51%). W kolejnych latach udział istniejących jednostek wytwórczych jest znacznie wyższy i stanowi kolejno: 91,67% dla 2022 roku

i 84,54% dla 2023 roku. Wyniki przeprowadzonej analizy wskazują także na znaczący udział jednej grupy kapitałowej, w ramach której znajdują się przedsiębiorstwa wytwarzające energię elektryczną. Największa moc zakontraktowana została przez przedsiębiorstwa należące do Grupy Kapitałowej Polska Grupa Energetyczna PGE SA: 51,95% całkowitego obowiązku mocowego na 2021 rok, 69,92% na 2022 rok i 64,44% na 2023 rok. Wolumen zakontraktowanej mocy wynosi dla każdego okresu dostaw ponad 70% całkowitej mocy zainstalowanej w Grupie Kapitałowej. Otrzymane wyniki analizy umożliwiają określenie struktury strony podaźowej rynku mocy w latach 2021–2023 oraz stanowią dane wejściowe do dalszych prac w zakresie modelowania krajowego systemu paliwowo-energetycznego.

SŁOWA KLUCZOWE: rynek mocy, aukcja mocy, mechanizmy wynagradzania zdolności wytwórczych, struktura rynku

