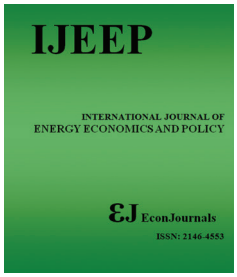


International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(6), 81-92.

Capacity Payments in the Turkish Electricity Market: A Necessity or Policy?

Aysun Korucan*, Okan Yardimci

Energy Market Regulatory Authority, Ankara, Turkey. *Email: akorucan@epdk.gov.tr

Received: 05 July 2023 **Accepted:** 02 October 2023 **DOI:** https://doi.org/10.32479/ijeep.14833

ABSTRACT

Capacity mechanisms have been implemented in different forms for various purposes. Contrary to altering trends in the electricity markets, Türkiye opted for enforcing "capacity payments," regarded as a primitive form of the mechanisms to ensure the security of supply and system reliability. This study mainly aims to build a critical review of the Turkish capacity mechanism design. The survey conducted makes valuable inferences along with the opinions of different stakeholders. The results indicate that the current capacity payment scheme, a non-market based, is not sustainable in the long run. Therefore, improving the existing payment methodology by reconsidering mechanism's scope and different age criteria, efficiency, and deliverability for plants or implementing other types of mechanisms with a market reform, such as demand response participation, seems more efficient.

Keywords: Electricity Market, Security of Supply, Capacity Mechanisms, Capacity Payments, Market Reforms, Türkiye
JEL Classifications: P18, Q28, Q41, Q48

1. INTRODUCTION

In energy-only markets, the electricity generators are rewarded only for their energy delivered to the grid. Under the assumption of competitiveness, each power plant offers a market price capturing their short-run marginal costs such as fuel and maintenance. The market-clearing price is determined by the intersection of supply and demand curves under the merit order rule, and the equilibrium price reflects the marginal cost of the last power plant that takes part in the electricity generation.

Today, the methods of electricity generation and electricity trade have been significantly altered. European electricity sector experiencing market liberalizations in the 1990s started to make efforts to reduce greenhouse gas emissions, which constitutes an example of this transition (EC, 2016). Along with incentives such as feed-in tariffs, the share of renewable energy sources has increased rapidly in installed capacity and electricity generation. Nonetheless, this increase has been brought by lower wholesale electricity prices since renewables offer low or even zero marginal costs to the market. Thus, the demand not increasing at the same rate as supply, lower prices, and lower utilization rates have adversely affected the profitability of conventional generation plants such as coal and gas. As a result, these baseload power plants have been unable to cover their capital expenditures (CAPEX) and operating expenditures (OPEX) over time (KU Leuven Energy Institute, 2013). This situation, also called the "missing money problem," compels the generators not to operate in the short run and finally shut down in the long term. Indeed, this problem mainly results from the price caps on electricity prices put by regulators to protect consumers and prevent abuse of the market power in the absence of demand elasticity (Stoft, 2002). Therefore, the plants that have a chance to operate only at peak times cannot fully meet their costs. In that sense, this bottleneck affects financial sustainability of the power plants and the success of energy-only markets in generating sufficient price signals to incentivize new investments (Bublitz et al., 2019). Furthermore, regarding system reliability, electricity systems must have sufficient resources to respond to unexpected power plant failures and or fluctuations in demand (van der Burg and Whitley, 2016).

Hence, properly designed and implemented capacity mechanisms can be an alternative to energy-only markets to solve the missing money problem and offer a more flexible generation capacity (KU Leuven Energy Institute, 2013).

In the mechanisms defined as "*administrative measures to ensure the achievement of the desired level of security of supply by remunerating generators for the availability of resources*" in Erbach (2017, p.2), specific incentives are offered to capacity providers in return for retaining available capacity or investing in new capacity. Today, capacity mechanisms are implemented with different motivations in many electricity markets. In France, the primary goal is to meet peak demand in the winter and encourage demand response participation (DRP). Unlike France, in Italy, the mechanism aims to meet peak demand in the summer and support the gas plants facing the threat of closure (Betz et al., 2015). Similarly, in the UK and Belgium, mechanisms started to be implemented to encourage new investments in the market and avoid shutdowns (Coibion and Pickett, 2014).

The first signals of implementing a capacity mechanism in the Turkish electricity market were given in 2008, and there had been ongoing debates about the possible mechanism choice and alternative market reforms since then. Finally, Türkiye opted for "capacity payments" among types of mechanisms in 2018 to ensure the security of supply and long-term system security. Since the capacity mechanism is a new implementation for the Turkish electricity market, studies on this issue are scarce. This study is the first candidate for evaluating the transition process of Turkish electricity market to capacity payments scheme and its design elements as a whole. In this way, it contributes to the growing literature on the mechanisms by adding Turkish practice. It examines the impacts of capacity payments in the market and discusses whether the existing capacity payments scheme is the most eligible one. Furthermore, it addresses alternatives other capacity mechanisms or market reforms based on the opinions of different stakeholders.

The study is composed of six sections. The capacity mechanisms in electricity markets are introduced in Section 2, the reasons for introducing a capacity mechanism in the Turkish electricity market are discussed in Section 3. While design principles of the mechanism are presented in Section 4, the survey on the Turkish capacity mechanism is introduced in Section 5. Finally, Section 6 concludes the paper.

2. CAPACITY MECHANISMS IN ELECTRICITY MARKETS

In electricity markets, there are different types of capacity mechanisms, and countries shift from one mechanism to another over time, depending on the market needs or the failure of the available mechanism. Generally, mechanisms can be classified into volume-based and price-based, as suggested by the Agency for the Cooperation of Energy Regulators (2013)[1]. As Erbach (2017) clarified, policymakers let the market set capacity price in the volume-based mechanisms after deciding on the required capacity. On the other hand, in the price-based mechanisms, they determine the price and then decide how much it will be invested for a given price to the market. Capacity auctions, capacity obligations, strategic reserves, and reliability options are the main types of volume-based mechanisms. On the other side, capacity payments as a price-based mechanism constitute the first step of the capacity mechanisms in many electricity markets today. It is noteworthy that there is a tendency for the markets to give up priced-based mechanisms and shift to volume-based ones, particularly to capacity auctions. Furthermore, there is another distinction between mechanisms such as centralized and decentralized ones. In centralized mechanisms, capacity is purchased by the system operator or government, while in non-centralized ones, it is procured by electricity suppliers or consumers (van der Burg and Whitley, 2016). In addition, centralized mechanisms have a long-term approach since the capacity procured has to be available within a few years following the procurement procedure (Benedettini, 2013). Conversely, decentralized ones with bilateral negotiations show a short-term approach since the contract duration may vary from 1 day to 1 year.

As a non-European example, in the Pennsylvania-New Jersey-Maryland (PJM), "Capacity Auctions" has been implemented since the first delivery year of 2007/2008 based on the reliability pricing model (RPM). Incremental auctions are held to achieve the resource adequacy target for the delivery year. Due to transmission restrictions and different supply and demand conditions, PJM is divided into sub-regions called "Locational Deliverability Areas." The RPM determines the demand curve by considering specific parameters such as installed reserve margin, cost of new entry, net energy, and ancillary services revenue offset for each region. Market-clearing price and target reserve level are determined at the intersection of demand and supply curves. Similarly, the UK adopted capacity auctions in 2014, abandoning the energy-only market.

In France, "Capacity Obligations" was launched in 2016 for the first delivery year of 2017. In the mechanism, electricity suppliers are obliged to hold a capacity certificate corresponding to the future peak demand of their customers four years before the target delivery year. Certificates can be obtained from suppliers' generation units (power plant or DRP) or other capacity operators (Réseau de Transport d'Électricité, 2014). Certification contracts are signed among the capacity providers and the system operator.

In Belgium, "Strategic Reserves" was introduced in 2014. In this mechanism, the system operator or regulatory body determines the required capacity level, while payments for capacity holders are set through a tender (van der Burg and Whitley, 2016). This reserve is applied only as a last resort in a supply shortage. The system operator punishes the capacity providers who cannot supply the amounts of energy agreed in the contract.

In Italy, "Reliability Options" was put into practice in 2019. In this mechanism, system operator and capacity providers sign long-term option contracts. In this way, a certain amount of capacity

1 Note that in some studies more or fewer categories are used. To illustrate, Tennbakk et al. (2013) distinguishes between strategic reserves, capacity payments and various forms of capacity markets.

is available in case of a supply shortage or a crisis in the national electricity system. Furthermore, positive differences between the spot price in the market and the strike price in the option contracts are paid back to the system operator. Thus, the regulatory authority redistributes these price differences to consumers through discounts on electricity bills (Salvi, 2015).

"Capacity Payments" has been implemented in many countries, such as the UK, Italy, Spain, Ireland, Greece, Portugal, and Türkiye. In this mechanism, central authority determines power plants' payments according to their installed or available capacity levels.

There is no consensus on which mechanism to choose under which conditions. Mechanisms have their advantages and disadvantages. To illustrate, the capacity auctions method can be effective provided that the target capacity level is determined correctly. Otherwise, it can result in excess capacity, so the costs reflected consumers increase, as observed in the UK in 2014, or it can end up with insufficient capacity and fail to ensure resource adequacy. In capacity obligations, in case of suppliers lack accurate long-term consumption forecasts, fluctuating prices for consumers and lacking long-term price signals for investors are inevitable (CREG, 2012). In strategic reserves, the plants included in the mechanism cannot offer electricity to the energy market and are entirely financed through capacity payments. This reduces the mechanism's efficiency in the long term and makes retention of reserve costlier (Bonn and Reichert, 2015). Capacity payments can become open to pressures and political interventions by market participants ambitious to receive more payments (CREG, 2012). For reliability options, it is critical to determine the strike price properly, ensure price stability, and encourage DRP against sudden price increases simultaneously (KU Leuven Energy Institute, 2013).

3. REASONS FOR INTRODUCING A CAPACITY MECHANISM IN TURKISH ELECTRICITY MARKET

The global crisis in 2008 affected electricity consumption in Türkiye considerably. Based on the data compiled by the Turkish Statistical Institute (2020a; 2020b), even though GDP and net electricity consumption per capita recovered rapidly after the crisis, they could never reach the same growth rates as in 2011. Despite the increase in electricity demand in the following years, contrary to expectations, annual growth rates did not exceed 5% until 2017. Indeed, electricity consumption per capita decreased in 2019 compared to the previous year. As a result, electricity consumption per capita in Türkiye followed a stable course in general over time.

The share of the private sector in the installed capacity, which was behind the public sector until 2010, has increased significantly with expectation of further demand increase. This gap has widened in time, along with new investments. By the end of 2019, 79% of the total installed capacity comprised of private sector generation facilities (TEIAS, 2020a). Based on TEIAS (2020a) data, the installed capacity in Türkiye, which was 40,836 MW in 2007, reached 91,267 MW in 2019, with an increase of 123%. Indeed, despite the sharp decrease in demand growth, particularly after 2011, installed capacity increased remarkably along with new investments until the end of 2013. Nonetheless, as seen in Figure 1, its growth also slowed after 2017.

Türkiye can meet its peak demand through its available and installed capacity levels. Based on TEIAS (2019) data, the peak demand of Türkiye in 2019 was realized as 49,281 MW on July 31, where installed and available capacity levels at that moment were 85,127 MW and 51,493 MW, respectively.

Based on EPIAS and TEIAS data, the increase in the installed capacity in 2019 compared to 2014 was realized as 60%, 32%, and 17% for renewable energy, coal, and gas plants, respectively. The average generation level of renewable energy and coal plants increased by 136% and 61%, respectively, for the same period, while gas plants decreased by 53%. The capacity factor of gas plants was 62% in 2014, reduced to 25% in 2019. Furthermore, the decrease in market prices threatened gas plants' operating hours and profitability. Thus, gas power plants became more disadvantageous over time due to the shrinking demand, penetration of renewable resources into the grid, and falling market prices.

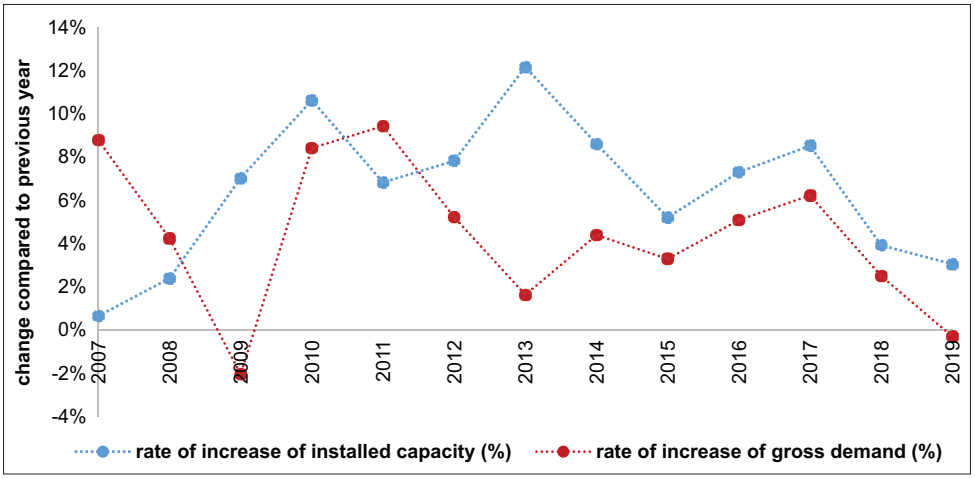
Consequently, Türkiye introduced a capacity mechanism in 2018, prioritizing domestic resources in line with the National Energy and Mining Policy. Undoubtedly, another purpose of the mechanism was to keep the gas plants in the system, which were built by the private sector in the past with the expectations of demand growth, but faced the risk of closure later.

4. DESIGN PRINCIPLES AND FIRST IMPLEMENTATIONS OF CAPACITY MECHANISM IN TÜRKIYE

Introducing a capacity mechanism in the Turkish electricity market had been discussed for years. The plan of establishing a capacity mechanism was first mentioned in an amendment to the Law in 2008. Since then, various mechanisms such as capacity auctions, capacity obligations, and strategic reserves had occasionally been argued. In 2016, the law was amended again to establish a capacity mechanism prioritizing domestic resources in line with the national energy policy. ultimately, the capacity payments scheme was implemented following a Regulation at the beginning of 2018. This regulation covered the issues of the application procedure, determination of the annual budget, and realization of payments to plants. Nonetheless, before long, certain modifications in the regulation were made in early 2019.

In the original form of the regulation, the primary beneficiaries of the capacity payments were coal and gas plants. Renewable power plants were excluded from the mechanism, as most benefited from feed-in tariffs. The criterion of at least 50% efficiency in the application process was eligible only for the power plants utilizing non-domestic resources. In 2019, hydroelectric power plants, whose reservoir areas do not exceed fifteen square kilometers, were also included in the mechanism. Furthermore, the maximum

Figure 1: Development of installed capacity and gross demand in Türkiye between 2007 and 2019



Source: Authors' elaboration, based on "Electricity Generation-Transmission 2019 Statistics" published by TEIAS (2020a)

age criterion for the power plants utilizing non-domestic resources increased from 10 to 13 years. The total installed capacity entitled to be included in the mechanism, which was 20,000 MWe in 2018, reached 23,000 MWe in 2020. Coal plants constituted 50% of the remunerated capacity in 2020, while the share of gas and hydroelectricity power plants were 43% and 7%, respectively.

In the first design of the mechanism in 2018, the monthly payments made to plants were based on parameters of capacity utilization rate, capacity levels, fixed and variable costs, and market-clearing prices. Furthermore, fixed costs determined annually were revised monthly concerning exchange rate, inflation, and capacity-related transmission costs. Similarly, variable costs as a critical determinant of payments were updated monthly according to inflation, generation-related transmission costs, and fuel costs. In this payment scheme, when the market-clearing price exceeded the total cost, plants received no payments.

The distribution of the payments was significantly affected by the fluctuations in market-clearing prices and exchange rates in the second half of 2018. The share of gas plants in total payments, which was 45% in January-July, increased to 76% between August and October. On the other hand, the share of coal plants decreased from 55% to 23% during the same period. As a result, gas plants received much higher payments than coal plants, contrary to what the law envisaged. This shift necessitated an amendment to the regulation in 2019. After this amendment, capacity payments started to be determined based on the parameters of installed capacity, fixed costs by resource type, and capacity utilization rates. As seen in Figure 2, the monthly payments received by domestic coal plants in 2019 exceeded those by gas plants. Thus, coal plants gained a critical advantage again in terms of payments.

The total payments to plants, which were 1.4 billion TL in 2018, reached 2.2 billion TL in 2020. Figure 3 illustrates the distribution of payments by different energy sources in 2020; domestic coal and imported gas plants had the largest share, with 54% and 37%, respectively. On the other hand, the share of hydroelectric power plants in payments is realized as 7%. In the Turkish mechanism, capacity payments are equally financed by the producers and consumers, who are the users of the transmission system. Therefore, the mechanism offering monthly fixed payments to certain plants is criticized for being a financial burden on both sides.

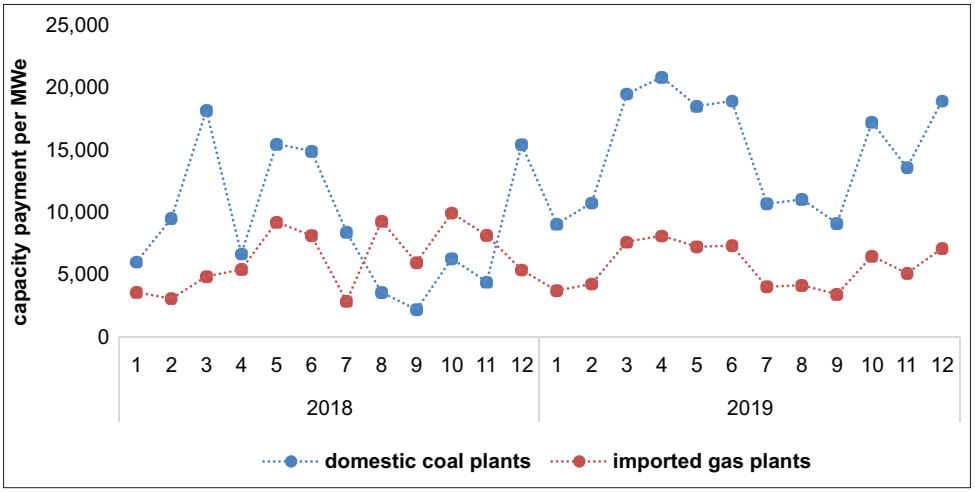
As a recent change, as of 2022, a mixed payment methodology started to be implemented in the Turkish mechanism. In the new scheme, half of the monthly budget allocated to capacity payments are distributed according to market-clearing prices and the other half based on fixed costs. Accordingly, the capacity payments method is not satisfying with its setup in 2018 or 2019 for all market players, so a hybrid one is applied.

5. A SURVEY ON CAPACITY MECHANISM IN TÜRKIYE

Within the scope of this study, a survey was conducted with the participation of the regulator (EMRA) representatives, sector players, and policymakers (Ministry and TEIAS). All interviewees had a deep knowledge of capacity mechanisms, even though some took a active role in initiating the capacity payments. Twenty-five participants, such as ten experts from EMRA, eight sector players, and seven policymakers, participated in the survey. At the end of the study, it was intended to reveal the first impacts of capacity payments on the market from different perspectives. The details of the survey questions and answers are presented in the Appendix 1.

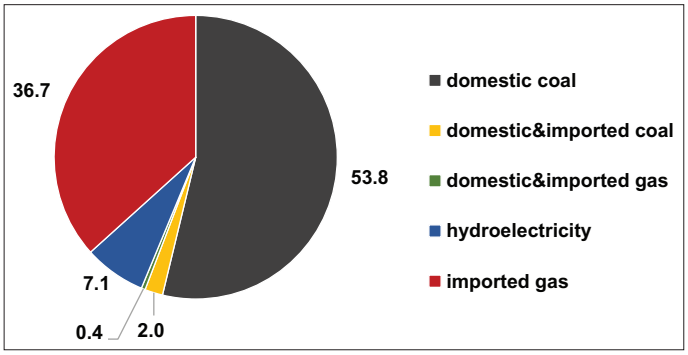
The survey results indicate that the mechanism adversely affects market-based price formation, and the Turkish electricity market moves further away from its liberal structure. The gas plants installed with high initial CAPEX fall behind in the price race today and face the risk of shutting down. Domestic coal power plants, privatized at high prices, struggle to ensure financial sustainability. Although the mechanism was designed to ensure sufficient installed power and system reliability, another important purpose was to offer financial support to gas and coal plants.

Figure 2: Comparison of monthly payments per installed capacity to coal and gas plants in 2018 and 2019 (TL)



Source: Authors' elaboration, based on data from "Electricity Generation-Transmission Statistics" and "Capacity Mechanism Payment Lists," both published by TEIAS (2020a; 2020b)

Figure 3: Distribution of capacity payments by energy sources in 2020 (%)



Source: Authors' elaboration, based on data from "Mechanism Payment Lists" published by TEIAS (2020b)

Based on the responses of the participants, the regulatory authority is more cautious about the capacity payment method. Sector players think a mechanism should be adopted but do not find the current implementation optimal. Lastly, policymakers consider the capacity payment method a viable option despite its shortcomings.

EMRA experts evaluate that the primary purpose of Türkiye's integrating a capacity mechanism into the market is to prevent the power plants from shutting down. Therefore, it is a positive development in a sense. Nonetheless, participants are unsure whether the costs to be borne in the future due to insufficient capacity will be greater than the payments today. They do not have a consensus on whether consumers pay the debts of the private sector through the mechanism. All experts agree that determining capacity payment amounts is open to political interventions. They find the payment scheme in 2018 insufficient but more market-based than in 2019. Even though they consider that capacity payments may distort the market in the long run, they mostly vote not to give up capacity payments. On the other hand, experts think that the method of capacity auctions is a better option for the Turkish electricity market than capacity payments. They consider the market reforms[2] proposed by the European commission (EC) essential for Türkiye, but they are hesitant about their short- or medium-term applicability.

Sector players think that the primary purpose of Türkiye's launch of a capacity mechanism is to prevent the power plants from phasing out and to ensure supply and system security. Therefore, they believe that implementing the mechanism is a positive development. They mostly agree that the costs incurred due to insufficient capacity in the future will be greater than the capacity payments today. Nonetheless, they partially agree that consumers are paying the private sector's debts through the mechanism. The participants point out that setting capacity payment amounts is open to political interventions to a large extent. While they state that the methodology in 2018 was more compatible with international practices, they find that the one in 2019 was more predictable for plants regarding cash flows. Assessing that capacity payments will not distort the market in the long run; all participants vote not to give up capacity payments. According to the sector players, capacity auctions, reliability options, or strategic reserves are more suitable than capacity payments. Moreover, they find that DRP, among the three market reforms proposed by the EC, is more applicable to the Turkish electricity market.

Policymakers assess that Türkiye's primary purpose of introducing a capacity mechanism is to avoid power plant closures, so it is generally a positive development for the electricity market. Participants advocate that the costs incurred due to insufficient capacity in the future will be greater than the capacity payments today. Furthermore, they disagree with the view that consumers pay the private sector's debts through the mechanism. They consider setting the amount of capacity payments is not open to political interventions. They state that the payment methodology

2 These market reforms are be applied before or while introducing a capacity mechanism are to allow Demand Response Participation (DRP) in the market, to remise shallow price caps and allow prices to rise to reflect consumers' willingness to pay (Value of the Lost Load (VoLL)), and lastly, to constitute bidding zones that will stimulate investments in capacity (EC, 2016).

2018 was more accurate, while the one in 2019 is more compatible with the mechanism's purpose. Pointing out that capacity payments may partially distort the market in the long run, policymakers mostly vote not to abandon capacity payments. Like sector players, policymakers view capacity auctions, reliability options, or strategic reserves are more viable alternatives to capacity payments. They find that introducing the bidding zones is the most essential one among the three market reforms proposed by the EC for the Turkish electricity market.

According to the survey, the views of the three groups are centered on not giving up capacity payments under the current conditions. However, participants do not think that the existing mechanism is working correctly. All groups emphasize that if the capacity payment method continues, the deficiencies in the mechanism should be corrected as soon as possible. They generally believe that the predictability of payments increased, particularly with the new payment scheme in 2019. However, they consider it has been moved further from a market-based structure. While some participants criticize the inclusion of hydroelectric power plants and coal plants with purchase guarantees in the mechanism, the others also argue that supporting coal plants in this way is a requirement of the National energy policy. Regarding capacity payments, conducting a study on the CAPEX and OPEX of plants, prioritizing efficient power plants over inefficient ones, and developing a deliverability parameter based on the availability of plants are some suggestions offered by the participants. Considering plants' variable costs, such as indebtedness ratios, loan liabilities in payments are also critical for power plants' financial sustainability. Different methodologies can be developed for power plants instead of a homogeneous payment scheme by grouping them based on the fuel type. Furthermore, it is emphasized that a mechanism considering regional constraints is essential for the Turkish electricity market. Currently, the alternatives suggested are capacity auctions and reliability options, which are market-based methods, and keeping strategic reserves in these regions. The market reforms proposed by the commission are appropriate for the Turkish electricity market. On the other hand, due to political concerns, the VoLL-based price caps and the constitution of bidding zones are unlikely to be implemented in the short term. Thus, DRP seems to be the first alternative but it requires additional infrastructure investments.

6. CONCLUSION AND POLICY IMPLICATIONS

Ensuring system reliability and security of supply constitutes one of the main objectives in electricity markets. Nevertheless, the rapid increase in the share of renewable energy resources brought some specific problems. As electricity demand did not increased at the same rate as generation, it became inevitable for conventional power plants to decrease their profitability due to falling market prices. Over time, this situation threatened system reliability in the short-term, security of supply, and system adequacy in the medium and long term. In this regard, authorities came up with alternative solutions. Implementing a capacity mechanism has been a frequently applied method in markets.

Türkiye introduced capacity payments in 2018. One of the objectives of the mechanism was to promote domestic coal plants in parallel with the National energy policy. However, undoubtedly, the main reason was to keep gas plants in the system, built by the private sector after 2010 with expectations of demand growth, but face the risk of closure later. Nonetheless, the mechanism has been criticized since the beginning. These criticisms have centered on the fact that the primary purpose of the capacity mechanism should not be to help investors to meet their costs but to ensure supply security.

In a sense, the mechanism contributes to the financial sustainability of power plants with monthly fixed payments. In this way, the plants that ensure the medium and long-term security of supply can survive in the system. However, the current capacity payments scheme has some deficiencies and seems not to be sustainable.

In this context, remuneration of the capacity that needs to be protected and that will contribute to the security of supply is a more effective strategy than supporting all power plants that meet specific criteria. In addition, making certain deductions in the capacity payments of the coal power plants that benefit from purchase guarantees is another option. Applying age and efficiency criteria to all power plants can effectively decrease the costs of supporting old and inefficient plants. Making payments based on regional constraints is an essential step in improving the optimality of payments. Another suggestion is to impose certain sanctions, such as excluding from the mechanism or withdrawing all payments from the plants that cannot be activated with an instruction. However, they declared that they would be available.

The feasible alternatives to capacity payments are market-based mechanisms such as capacity auctions or reliability options. Constraint management is one of the main problems in the Turkish electricity market, and constraint-related costs continue for generators and consumers. To overcome this problem, just as in the PJM and the UK, capacity auctions can be held in the urgent constraint zones of Türkiye for the difference between targeted and expected available capacity levels. The income obtained from competitive tenders can finance the transmission investments in these regions, reducing constraints. Implementing the strategic reserves method on a regional basis can be another option, considering it may cost consumers more.

In addition to a mechanism, if a reform is to be implemented in line with market needs, integrating DRP into the grid with rapid infrastructure investments seems reasonable. Exceptionally, DRP, along with market-based mechanisms such as capacity auctions and reliability options, will provide flexibility and reduce the costs caused by loading and de-loading instructions. DRP will bring lower wholesale market prices with its ability to replace the most expensive peak generation resources. Furthermore, reducing fossil fuel dependency in the country will eliminate the integration problems of renewable energy resources into the grid. Determination of VoLL-based price caps and the formation of regional prices are the other essential steps. Indeed, the VoLL offers an effective tool for revising decisions on resource adequacy. The construction of bidding zones promotes new investments in the

grid and acceleration of industrialization throughout the country. Nonetheless, political and social concerns and the ones of abuse of market power are the main barriers to introducing these two reforms. Thus, they do not seem to apply to the Turkish electricity market in the short term.

7. ACKNOWLEDGMENTS

This research has not received any specific grant from public, commercial, or not-for-profit funding agencies. We want to express our special thanks to the respondents who participated in the survey.

REFERENCES

Agency for the Cooperation of Energy Regulators. (2013), Capacity Remuneration Mechanisms and the Internal Electricity Market. Available from: https://www.acer.europa.eu/official_documents/acts_of_the_agency/publication/crms%20and%20the%20iem%20report%20130730.pdf [Last accessed on 2023 Mar 30].

Benedettini, S. (2013), PJM and ISO-NE Forward Capacity Markets: A Critical Assessment. Research Report Series. Available from: https://www.iefe.unibocconi.it/wps/wcm/connect/76674f79-945d-4522-a129-8fae16e18628/Report+EC.pdf?MOD=AJPERES [Last accessed on 2023 May 20].

Betz, R., Cludius, J., Riesz, J. (2015), Capacity Remuneration Mechanisms: Overview, Implementation in Selected European Jurisdictions, and Implications for Switzerland. Available from: https://digitalcollection.zhaw.ch/handle/11475/1143 [Last accessed on 2020 Apr 01].

Bonn, M., Reichert, G. (2015), Capacity mechanisms-an option for ensuring an affordable and secure electricity supply in the EU? Vol. 5. Belgium: Centre for European Policy, cepInput. p1-24. Available from: cep.eu/Studien/cepInput_Kapazitaetsmechanismen/cepInput_Capacity_mechanisms.pdf [Last accessed on 2023 Apr 13].

Bublitz, A., Keles, D., Zimmermann, F., Fraunholz, C., Fichtner, W. (2019), A survey on electricity market design: Insights from theory and real-world implementations of capacity remuneration mechanisms. Energy Economics, 80, 1059-1078.

Coibion, A., Pickett, J. (2014), Capacity Mechanisms. Reigniting Europe's Energy Markets. Brussels: Linklaters. Available from https://www.linklaters.com/pdfs/mkt/london/6883_lin_capacity_markets_global_web_single_final_1.pdf [Last accessed on 2023 Jun 04].

Commission for Electricity and Gas Regulation (CREG) (2012), Study on 'Capacity Remuneration Mechanisms. Available from: https://www.creg.info/pdf/etudes/F1182en.pdf Last accessed on 2023 Mar 28].

Erbach, G. (2017), Capacity Mechanisms for Electricity. European Parliamentary Research Service (PRS). Available from: https://www.europarl.europa.eu/regdata/etudes/brie/2017/603949/eprs_bri(2017)603949_en.pdf [Last accessed on 2023 May 18].

European Commission (EC). (2016), Final Report of the Sector Inquiry on Capacity Mechanism. Available from: https://eur-lex.europa.eu/legal content/en/txt/pdf/?uri=celex:52016DC0752&from=en [Last accessed on 2023 Apr 14].

KU Leuven Energy Institute. (2013), El-Fact Sheet Capacity Mechanism. London: KU Leuven Energy Institute.

Réseau de Transport d'Électricité. (2014), French Capacity Market Report Accompanying the Draft Rules. Available from: https://www.rte-france.com/sites/default/files/20140409frenchcapacitymarket.pdf [Last accessed on 2023 Apr 28].

Salvi, U.P. (2015), Capacity Payment in Italy and the German Case. Available from: https://www.cliffordchance.com/briefings/2015/04/capacity_paymentinitalyandthegermancase.html [Last accessed on 2023 Apr 09].

Stoft, S. (2002), Power System Economics: Designing Markets for Electricity. Wiley-Interscience, Piscataway, New Jersey and New York: IEEE Press.

TEIAS. (2019), Dispatcher Information System Daily Operation Results. Available from: https://ytbsbilgi.teias.gov.tr/ytbsbilgi/frm_istatistikler.jsf [Last accessed on 2023 Mar 15].

TEIAS. (2020a), Turkey Electricity Generation-Transmission Statistics 2020. Available from: https://www.teias.gov.tr/tr-TR/turkiye-elektrik-uretim-iletim-istatistikleri [Last accessed on 2023 Feb 12].

TEIAS. (2020b), Capacity Mechanism Payment Lists. Available from: https://www.teias.gov.tr/tr-TR/sektor-raporlari [Last accessed on 2023 Apr 10].

Tennbakk, B., Capros, P., Delkis, C., Tasios, N., Zabara, M., Noreng, C.H., Jenssen, Å. (2013), Capacity Mechanisms in Individual Markets within the IEM. Report to the European Commission DG Energy, Prepared by Thema, E3MLab (NTUA) and COWI.

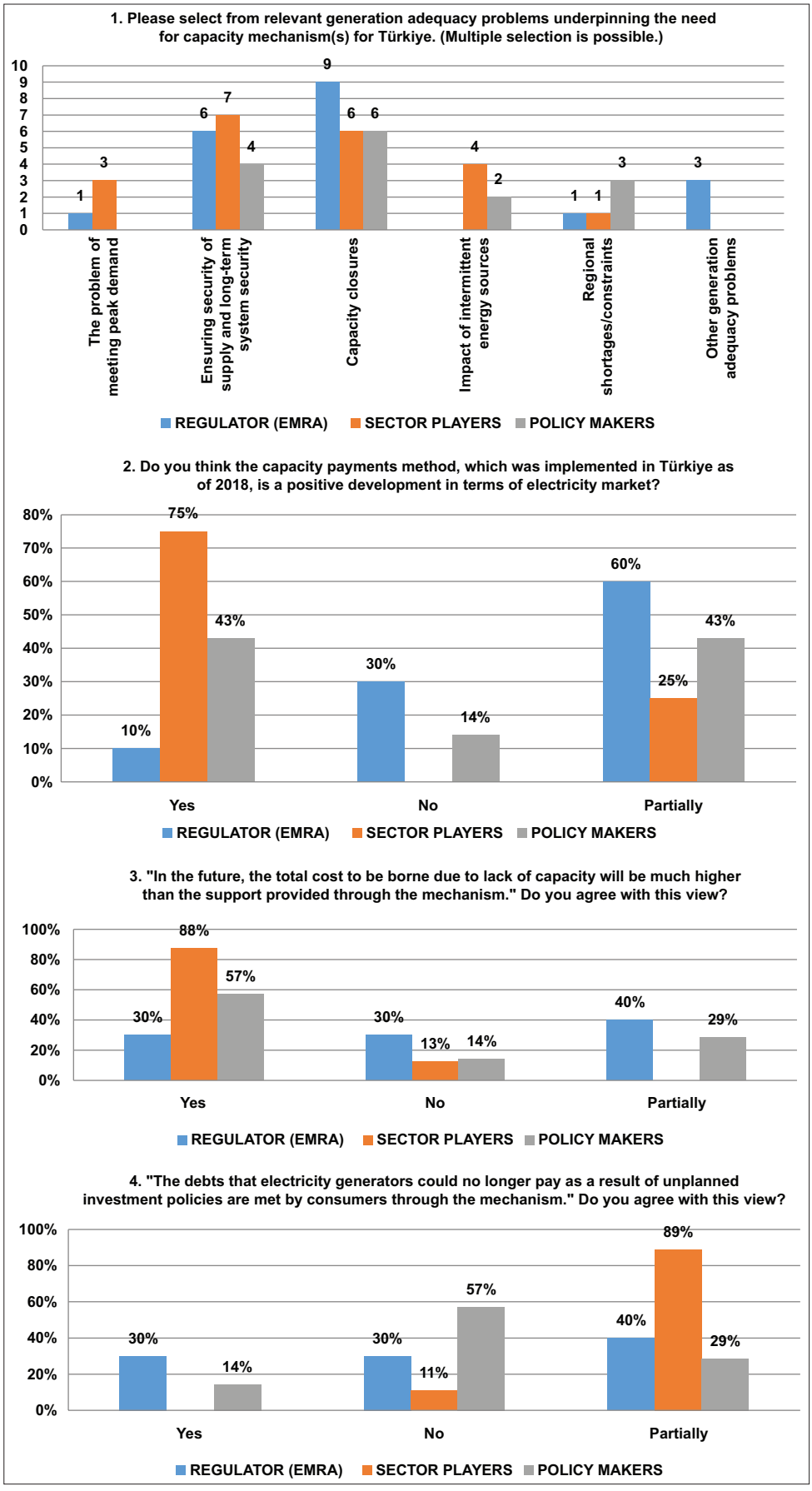
Turkish Statistical Institute. (2020a), Power Installed of Power Plants, Gross Generation and Net Consumption of Electricity. Available from: https://tuikweb.tuik.gov.tr/pretablo.do?alt_id=1029 [Last accessed on 2023 Apr 12].

Turkish Statistical Institute. (2020b), Gross Domestic Product by Provinces by Kind of Economic Activity, Current Prices, 2004-2019. Available from: https://tuikweb.tuik.gov.tr/PreTablo.do?alt_id=1075 [Last accessed on 2023 Apr 12].

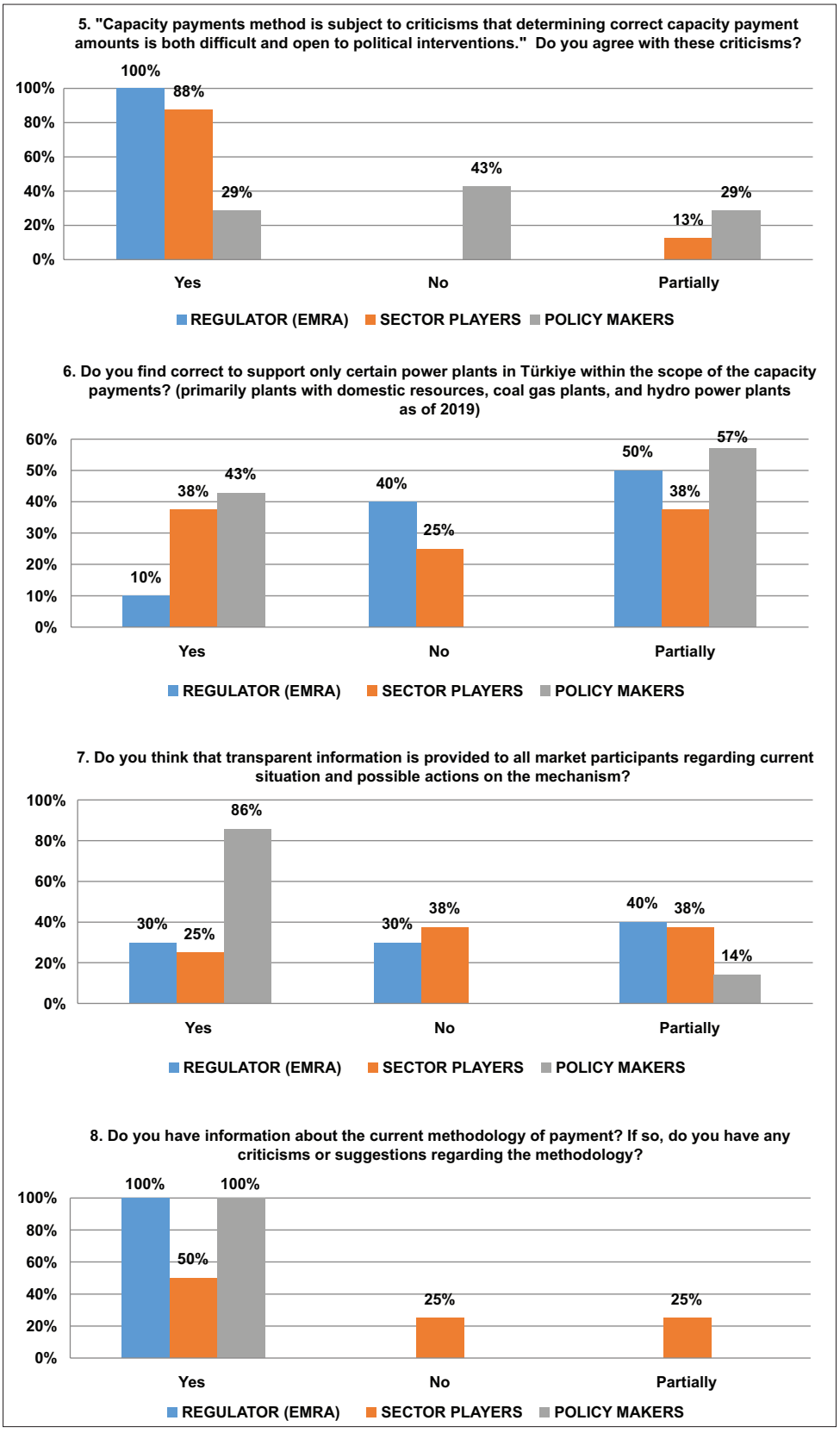
Van der Burg, L., Whitley, S. (2016), Rethinking Power Markets: Capacity Mechanisms and Decarbonisation. London: Overseas Development Institute. Available from: https://www.odi.org/sites/odi.org.uk/files/resource-documents.pdf/10569 [Last accessed on 2023 Mar 28].

APPENDIX

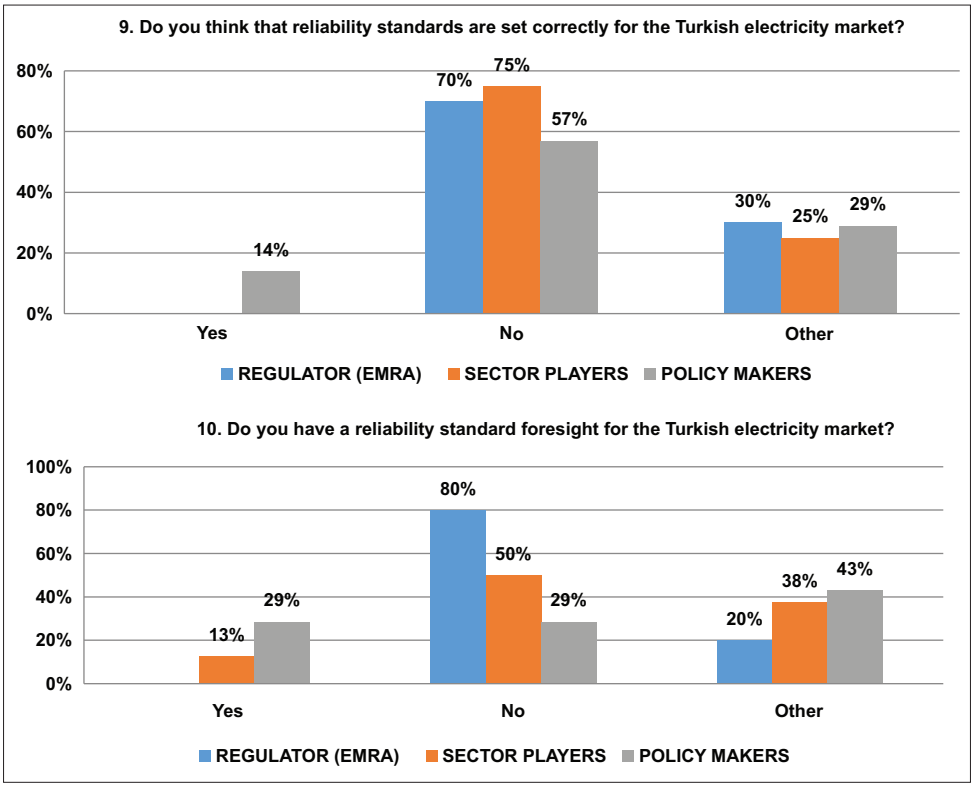
Appendix 1: Survey questions and evaluation of answers by groups



Appendix 1: *(Contd...)*



Appendix 1: *(Contd...)*



11. Considering the reliability standard in the USA PJM region, it is predicted that an installed power capacity of 16% should be maintained above the peak consumption in 2019. In your opinion, what % of installed power above peak consumption would be sufficient for Türkiye? (Open-ended).

Foremost answer(s) of Regulator:

- The system operator, TEIAS, should make such calculations, and predictions are difficult.
- Assuming that the installed power in the question is the baseload (available) plant, such a ratio is not necessary for today's technology.

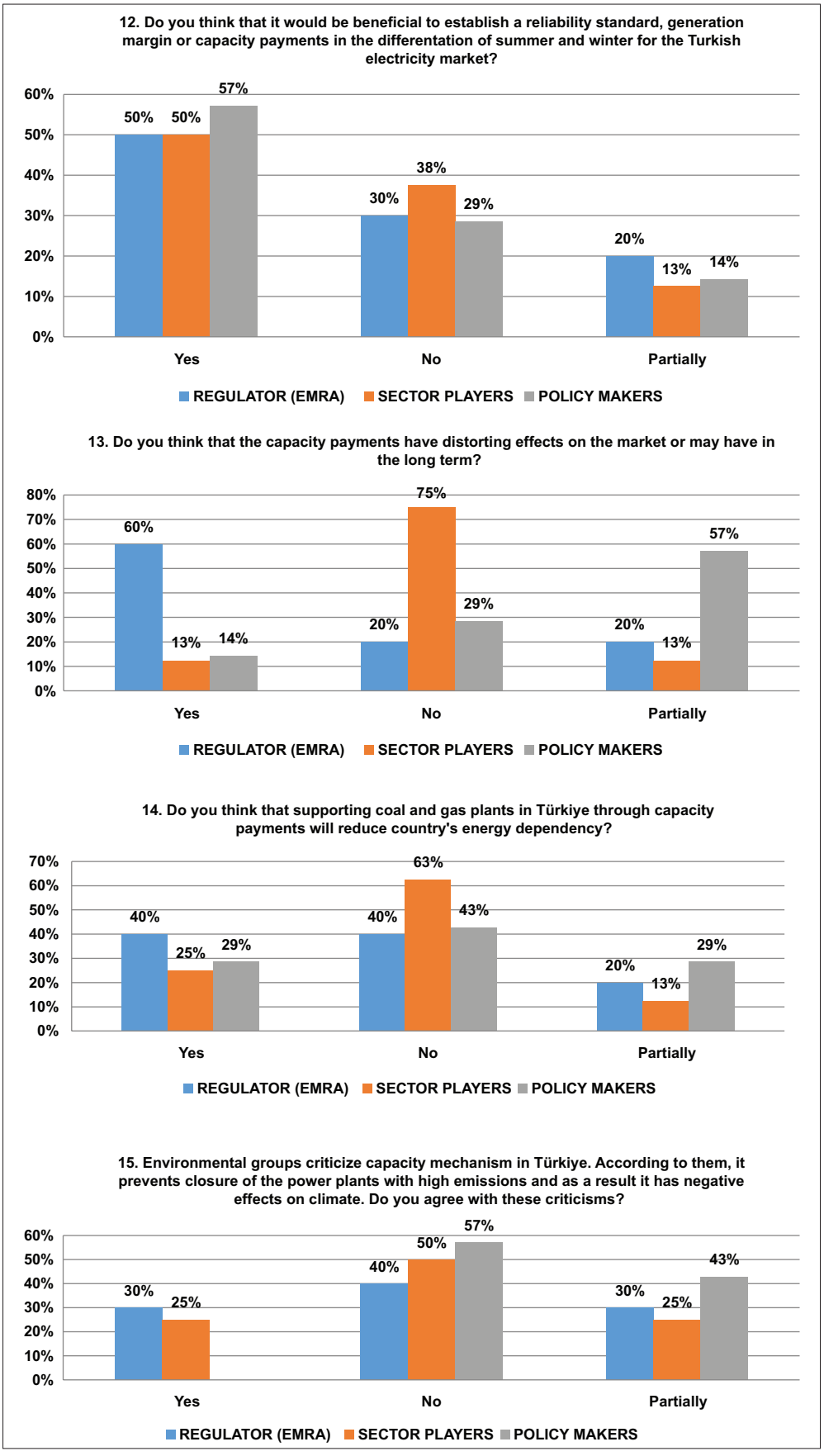
Foremost answer(s) of sector players:

- A reasonable reserve capacity amount should be calculated using maintenance programs and other technical availability rates and considering the supply difficulties that may occur in different resource types.
- Considering the total installed capacity of renewable generation resources with their irregular generation in our country, this ratio should be at least 30-40%.
- In the current market, I think 20% is sufficient economically and technically.

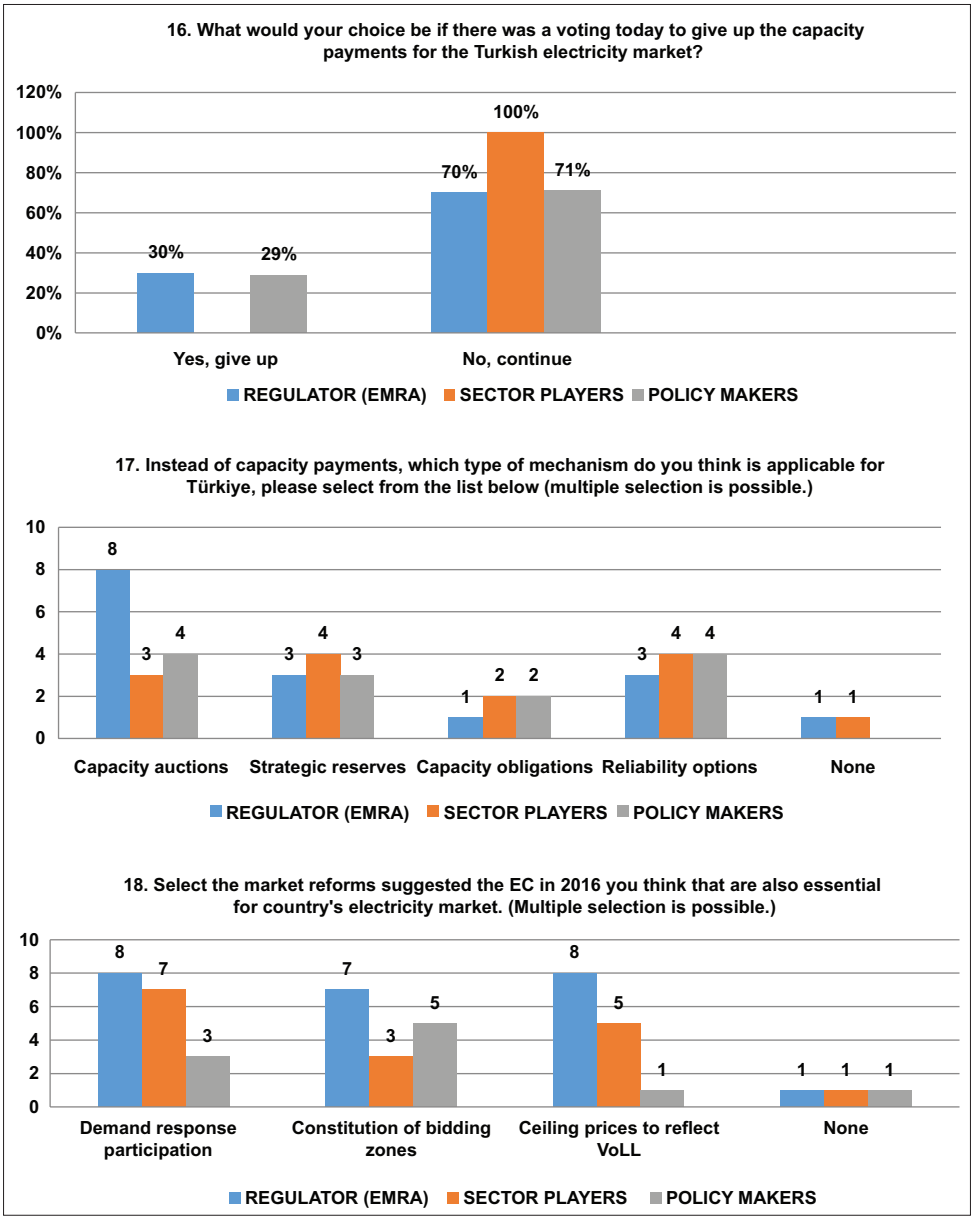
Foremost answer(s) of policymakers:

- Considering the share of renewable energy resources, we must keep the installed capacity at 40% more than peak consumption.
- It should be between 20% and 30% (as available power).
- I do not think such a capacity is needed in the current situation.

Appendix 1: *(Contd...)*



Appendix 1: *(Contd...)*



19. What do you think is the fundamental problem of the Turkish electricity market? (Open-ended)
Foremost answer(s) of Regulator: Not leaving the market to its functioning, not allowing price fluctuations, and giving incentives to plants in an uncontrolled manner are the main problems of the market.

Foremost answer(s) of sector players: The main problem is the absence of price formation based on transparent and free-market conditions.

Foremost answer(s) of policymakers: Legislative changes occur too often, so predictability for the market is low. Furthermore, even new investors immediately expect incentives; free-market logic is not taken for granted. Economic fluctuations affect the market, and financial risks are very high.