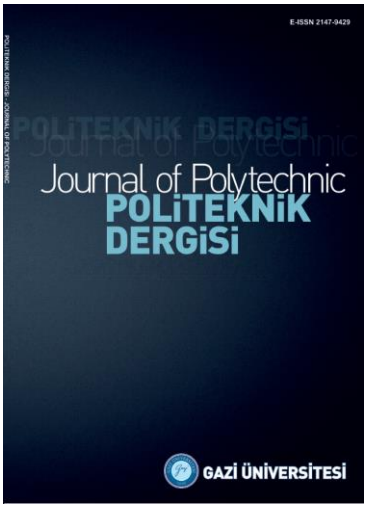

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Enhancing the renewable energy auctions in Turkey

Türkiye'de düzenlenen yenilenebilir enerji ihalelerinin güçlendirilmesi

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Enhancing the Renewable Energy Auctions in Turkey

Highlights

- *Feed-in-Tariff has driven rapid growth in renewable markets.*
- *Renewable auctions to be carried out should be smaller in volume and be distributed across different geographical regions.*

Graphical Abstract

An overview of the design criteria of the renewable energy auction mechanism has been provided and recommendations as required to improve the effectiveness of this mechanism has been made.

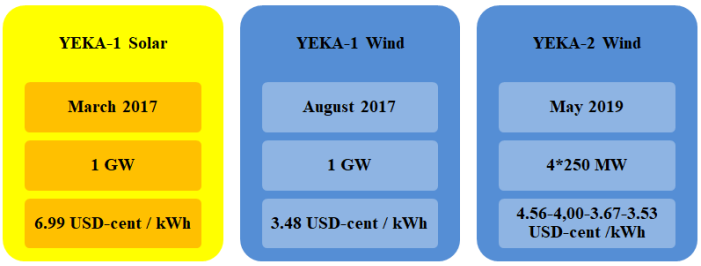

Figure. The date of tenders, volumes and the prices of the winning bids in Turkey.

Aim

The aim of this study is to provide an overview of the design criteria of the renewable energy auction mechanism and to make recommendations as required to improve the effectiveness of this mechanism.

Design & Methodology

Auction design criteria were examined and compared with practices in Turkey.

Originality

An overview of the design criteria of the renewable energy auction mechanism has been provided based on literature and recommendations as required to improve the effectiveness of this mechanism has been presented in comparison with auction applications in Turkey.

Findings

YEKA tenders lack long-term planning with no regular frequency. A large-scale capacity-based auction volume through a single tender created enough competition and large volumes of renewable energy being secured at lower pricesin Turkey.

Conclusion

Within the scope of long-term plans, YEKA auctions with determined frequency should be carried out.

Declaration of Ethical Standards

The author of this article declares that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

Enhancing the Renewable Energy Auctions in Turkey

Araştırma Makalesi / Research Article

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ABSTRACT

Auction mechanism has been a promising market-based mechanism to promote the generation of electricity from renewable energy sources (RES-E).The success of this mechanism relies on accurate determination of auction design criteria in view of country specifics. Turkey is one of the countries applying this mechanism. The aim of this study is to provide an overview of the design criteria of the renewable energy auction mechanism and to make recommendations as required to improve the effectiveness of this mechanism. Assessments and recommendations as part of this study shall seek to provide an opportunity to review such auction design criteria, benefiting from past experiences, which shall in turn enhance the effectiveness of new auctions. Applied incentives have boosted the share of RES-E in Turkey in the last ten years. Feed-in-Tariff has driven rapid growth in renewable markets and enhanced manufacturing industries. This analysis results show that a large-scale capacity-based auction volume through a single tender created enough competition and large volumes of renewable energy being secured at lower prices. Within the scope of long-term plans, auctions should be held regularly at predetermined intervals in order to facilitate market predictability for investors, and could lead to competition. Renewable auctions to be carried out should be smaller in volume and be distributed across different geographical regions.

Keywords: Renewable energy sources, auction mechanism, auction design criteria, tender.

Türkiye'de Düzenlenen Yenilenebilir Enerji İhalelerinin Güçlendirilmesi

ÖZ

İhale mekanizması, yenilenebilir enerji kaynaklarını kullanarak elektrik enerjisi üretimini teşvik etmede kullanılan piyasa tabanlı, etkin bir mekanizmadır. Bu mekanizmanın başarısı, ihale tasarım kriterlerinin ülke koşullarına özgü olarak doğru belirlenmesine bağlıdır. Türkiye uyguladığı Yenilenebilir Enerji Kaynak Alanları (YEKA) ihaleleri ile bu mekanizmanın uygulandığı ülkelerden biri olmuştur. Bu makalede amaç, yenilenebilir enerji ihale mekanizmasının tasarım kriterleri ile ilgili genel bir değerlendirme yaparak, uygulanmakta olan bu mekanizmanın etkinliğini artırmak amacıyla gerekli olan önerilerde bulunmaktır. Çalışma kapsamında yapılan değerlendirmeler ve sunulan öneriler, ihale tasarım kriterlerinin, gerçekleştirilen ihaleler tecrübesiyle gözden geçirilmesine olanak sağlayacak, yeni ihalelerin etkinliği artıracaktır. Son on yılda uygulanan teşviklerin sonucu olarak, Türkiye'de elektrik enerjisi üretimindeki yenilenebilir kaynakların payı artmıştır. Alım garantisi mekanizmasısını uygulanması sonucu yenilenebilir enerji sektörü gelişmiş, yerli aksam üretimi güçlenmiştir. Türkiye'de; tek parçalı, büyük hacimli ve kapasite bazlı ihaleler yapılmış, yeterli rekabet koşulları sağlanarak düşük fiyatla yenilenebilir kurulu güç artışı sağlama imkanı elde edilmiştir. Yeni ihalelerinin uzun dönemli bir plan çerçevesinde, düzenli aralıklarla gerçekleştirilmesi yatırımcılar açısından öngörülebilirliği artıracak, etkin rekabet koşulları sağlanacaktır. Yenilenebilir enerji ihaleleri daha küçük hacimli olarak düzenlenmeli ve farklı coğrafi bölgelere yayılmalıdır.

Anahtar Kelimeler: Yenilenebilir enerji kaynakları, ihale mekanizması, ihale tasarım kriterleri, yarışma.

1. INTRODUCTION

Detrimental impacts of fossil energy sources had a multiplier effect on the g lobal importance placed on renewable energy sources (RES) [1,2,3,4]. Shifting paradigms in energy policies led to a consideration of low-carbon economy-based energy supply policies as the new paradigm [4]. RES are the fastest growing sources globally and considered as the groundwork for carbon-free growth against increasing CO_2 emissions [5,6,7]. Technology cost for RES is plummeting, which is believed to continue also in upcoming years [5,8,9,10]. Lowered costs in solar and wind energy components, commercial expansion of technologies, the resulting competitive environment and increased efficiency in renewable energy technologies have led to significantly lowered costs in solar and wind technologies [8,9]. Feed-in tariff (FiT) and renewable portfolio standard became the most popular mechanisms used in order to increase the competitiveness of renewable energy plants against conventional plants [2, 11].

Increase in competitiveness of renewable energy technologies against conventional technologies also resulted in an increase in attention to the auction mechanism. This mechanism became a popular mechanism used for promoting renewable energy production lately and was implemented in 30 countries around the globe as of the end of 2016 [2,3,12-14]. Renewable energy auctions have gained popularity in some of the European Union (EU) countries to promote RES deployment [15].

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While there are different types of the auction mechanism, the effectiveness of this mechanism relies on the accurate determination of design criteria. Auction design criteria are determined based on the unique conditions of each country. Policy makers determine this criteria by evaluating the general policies and unique conditions of the country together [12,13]. The goal of renewable energy auctions is to determine the support prices for renewable energy technologies in a cost efficient way within sufficient competitive conditions by organizing tenders [16-20]. World-wide recent auctions have contributed to lowering the RES based generation prices [5]. The renewable energy tenders carried out around the world in 2016 and 2017 showed that renewable energy technologies can compete with fossil fuel technologies as of 2020, if correct policies and regulatory frameworks are developed without the need of financial incentives [8]. The auction mechanism is not alone enough to reach political goals and must be used with other supportive regulations [12].

Turkey has a significant RES potential, which is 13% of the total potential in EU-member states. Turkey's renewable energy generation potential is 240,165 GWh/yr., which corresponds to an installed capacity of some 138,000 MW [21]. Turkey's economic renewable energy potential by source is shown in Table 1[21].

Table 1. Turkey's RES potential by source

Source	Installed capacity (MW)	Generation (GWh / yr,)
Hydro	36,000	144,000
Geothermal	2,000	14,665
Wind	48,000	60,000
Biomass	2,000	14,000
Solar	50,000	7,500
Total	138,000	240,165

Turkey can make the best use of its significant potential for renewable energy, increase its share in the energy mix, reduce the impacts of fossil sources and establish a sustainable energy model [1, 21- 23]. Turkey's policy target for 2023 is to ensure 30% of its electricity generation is from renewables whereby electricity consumption in 2023 is estimated to reach 424 TWh. This forecast, if realized, requires an electricity generation of about 159 TWh in 2023 which requires the commissioning of 61 MW of new installed capacity. Contribution of each RES to achieve this target shall be as follows: 34 GW (91.80TWh) hydro, 20 GW (50.00 TWh) wind, 5 GW (8.00 TWh) solar, 1 GW (5.10 TWh) geothermal and 1 GW (4.53 TWh) biomass [21].

When utilization rates of these potentials and attainment rates for 2023 target is calculated according to renewable installed capacity as of end of 2018, the outcome is given in Table 2 [21,24].

The share of all RES in electricity generation in Turkey has increased in the last ten years. Despite this positive advancement, as Table 2 also suggests, Turkey has tapped into only 31% of its rich renewable energy potential as of end of 2018. Hydro power plants (HPPs) have been pivotal for Turkey's energy mix for long, which also constitute a significant portion of the nation's total installed capacity from sizeable reservoir-type plants. With the exception of geothermal power plants, utilization rates of other RES excluding HPPs is still low [21,24].

Turkey's wind energy projects must be accelerated to exploit its rich wind power capacity [23,25].

Decreased technology costs for RES enable a variation in Turkey's electricity generation mix [10]. Turkey plans to call the current Renewable Energy Sources Support Mechanism (YEKDEM) to a close in 2020.

FiT under YEKDEM was low and failed to attract sufficient investment in 2010 are comparatively higher today. The renewable energy source zones (YEKA) auction model put in practice in 2017 shall appease YEKDEM burden on public finances, paving the way for new investments. Auctions with duly defined criteria, included within long-term plans and which are to be performed regularly hold the potential to increase the installed capacity for RES with an appropriate price.

Table 2. Utilization of RES potentials and attainment rates for 2023 targests

Source	Economic Potantial (MW)	Installed capacity 2018 (MW)	Target installed capacity for 2023 (MW)	Utilization rates as of and of 2018 (%)	2023 Target attainment rates (%)
Hydro	36,000	28,239	34,000	78	83
Wind	48,000	7,005	20,000	15	35
Solar	50,000	5,063	5,000	10	101
Geothermal	2,000	1,283	1,000	64	128
Biomass	2,000	739	1,000	37	74
Total	138,000	42,328	61,000	31	69

Each country may adopt different auction models and set their own criteria as per their political goals. Auctions carried out in Turkey follow the hybrid method. The tender has two stages; in the first stage, bids are received in sealed envelopes and in the second stage, the winner is determined by underbidding. In tenders with a pre-disclosed ceiling price, some technical and financial competency conditions are in place which needs to be met in order to be able to place a bid. In the YEKA auction model adopted in Turkey, there is an auction design which emphasizes developing the production capacity for domestically produced components and increasing transfer of technology. The Ministry of Energy and Natural Resources (MENR) is responsible for all stages of YEKA auctions.

The purpose of this study is to examine how to improve the design criteria pertaining to the YEKA auction model and to offer suggestions in this regard. An examination of this kind would enable the revision of new auctions based upon the experience from the first auctions. In order to be able to implement the auction mechanism, a certain renewable energy installed capacity needs to be reached and a certain development of sector needs to have been achieved through the adoption of different incentive mechanisms. Therefore in the second section of this study, the RES incentive mechanisms adopted in Turkey and their effectiveness was evaluated, along with an in-depth dissection of developments in the renewable energy sector. In the third section, auction design criteria were examined as based on the literature and an evaluation was provided for each criterion in respect to the YEKA auction practice in Turkey. The fourth section provides results and discussion, and the final section offers some recommendations.

2. RENEWABLE ENERGY INCENTIVE MECHANISMS IN TURKEY

The high capital costs, once regarded as a barrier hindering the expansion of renewable energy, are no longer an obstacle thanks to the decrease in costs in renewable energy technologies, particularly, solar and wind power. If there is enough competition, it is possible to achieve a sustainable RES development through appropriate policies and implementations and far-reaching legislative arrangements. While having a rich variety of RES potential waiting to be tapped into, the only RES to have been exploited on a significant scale was sizeable HPPs until the 2000s in Turkey. With the law no. 5346 (Renewable Energy Law) enacted in 2005, the FiT incentive mechanism started to be utilized. Through this law, a procurement guarantee for electricity from renewable energy sources (RES-E) was provided over a fixed price. Within the scope of this arrangement, the support price to be provided for RES was determined each year by the Energy Markets Regulatory Authority (EMRA). The support price is the average wholesale price of electricity in Turkey for the previous year, which may fall anywhere between the 5.0 - 5.5 Euro-cent/kWh range. The law which was enacted with a view to increasing the share of RES-E within the total electricity generation did not bear the desired results due to the support price provided for all types of sources being the same and low, in turn failing to increase the RES installed power.

With the amendment made in the Renewable Energy Law in 2010, fixed FiTs depending on the technology was adopted and FiTs provided were increased with bonus tariff for domestically produced plant components (local-content). For the plants under the YEKDEM which are or will be commissioned until the date of 31 December 2020, FiT and local-content bonus under Table 3 are provided. The FiT is limited to 10 years and the bonus tariff for local-content is limited to first 5 years of operation. Within this framework, the first YEKDEM support was provided in 2011 and the first local-content bonus provided in 2014.

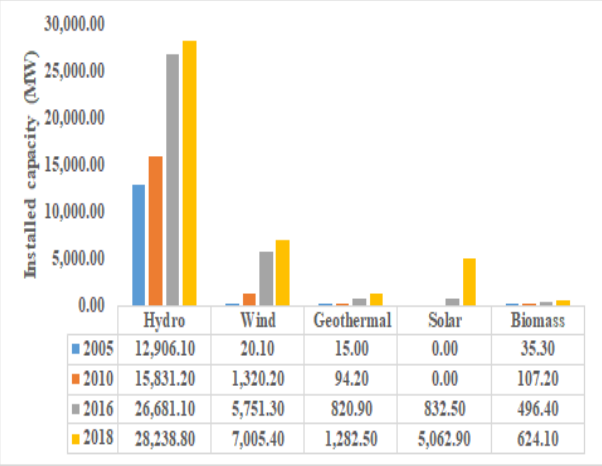
Table 3. The FiT and local-content bonus

Source	FiT (USD cent /kWh)	Max. local - content bonus (USD cent / kWh)
Hydro	7.3	2.3
Wind	7.3	3.7
Geothermal	10.5	2.7
Biomass	13.3	5.6
Solar-PV	13.3	6.7
Solar-CSP	13.3	9.2

In 2005 when the Renewable Energy Law was enacted, Turkey had a total installed capacity of 38,844 MW, and around 33% of the total installed capacity was made up of plants generating RES-E. 99% of the renewable installed capacity in 2005 was made up of HPPs. In 2010 when the Renewable Energy Law was amended, Turkey had a total installed capacity of 49,542 MW, increasing the renewable installed capacity to 17,353 MW. Making up the 35% of the total installed capacity in 2010, 91% of the renewable installed power consisted of HPPs. When compared with 2005, the increase in the share of RES in the energy mix was around 2% in 2010. Apart from hydro power, what contributed a marked contribution to this increase was wind power. While in 2005 the installed wind power capacity was 20.1 MW, it increased to 1,320 MW in 2010. No installed photovoltaic (PV) power plants were available between the years 2005 and 2010. Striking increases were observed in the renewable capacity following the amendment made in the Renewable Energy Law in 2010. In 2016, the total installed capacity in Turkey increased to 78,497 MW and the renewable capacity increased to 34,582 MW. In 2016, 44% of the total capacity consists of plants generating RES-E , and 77% of the renewable capacity comprises hydro power. When compared with 2010, the rate of increase in the share of RES was 9% in 2016. Within the 2010-2016 period, marked increases occurred in all types

of RES, with the highest increase apart from HPP in wind power. In 2014, PV power plants were also included in Turkey's electrical energy generation mix with an installed capacity of 40.2 MW. While in 2010 the installed wind power capacity was 1,320 MW, the same increased to 5,751 MW in 2016. Geothermal power increased from 94.2 MW to 820.9 MW and Hydro power increased from 15,831 MW to 26,681 MW in 2016 [24,26]. The development of Turkey's renewable capacity starting from 2005 when the Renewable Energy Law began to be implemented is shown in Figure 1 [24,26].

Figure 1. Development of Turkey's renewable installed capacity



In terms of wind power, the installed capacity development after 2005 saw ever increasing rates over the years, achieving an average annual increase of 30% from 2010 to 2016. In 2017 and 2018, a slowdown was observed in the growth rates for wind and solar power investments when compared with previous years. A growth rate of 12.55% in 2017 and 7.24% in 2018 was achieved in wind power [27]. From 2014 onwards, the installation of PV power plants accelerated in a notable manner. Within a short period of four years, an installed capacity surpassing 5 GW was reached, with an increase of 2.5 GW in 2017 and 1.6 GW in 2018. A significant share of this PV installed capacity is based on unlicensed power plants. As of the end of 2018, only 1.61% of PV power plants with a total capacity of 5,062 MW is made up of licensed power plants.

The YEKDEM practice has proven to be successful following the amendment made in 2010 and over the years, the number of plants benefiting from YEKDEM increased significantly. While in 2011 a total of 20 renewable power plants with an installed capacity of 610.23 MW were supported under YEKDEM, in 2018 a total of 708 renewable power plants with an installed capacity of 19,266.27 MW were supported. Expansion of renewable power plants supported under YEKDEM in the 2011-2018 period are given in Table 4 [28].

The share of plants benefiting from YEKDEM within the total renewable installed capacity is given in Table 5 [28].

According to the data provided under Table 5, while in 2011 the share of plants benefiting from YEKDEM support within the total renewable installed capacity was 3.19%, the same rate increased to 45.64% in 2018.

Table 4. Expansion of renewable energy power plants under YEKDEM

	2011		2012		2013		2014	
Source	**No**	**Installed capacity (MW)**	**No**	**Installed capacity (MW)**	**No**	**Installed capacity (MW)**	**No**	**Installed capacity (MW)**
Hydro	4	22.40	44	970.99	14	216.60	40	628.58
Wind	9	469.10	22	687.90	3	75.90	21	826.40
Geothermal	4	72.35	4	72.35	6	140.35	9	227.82
Biomass	3	46.43	8	75.32	15	101.09	23	150.83
Solar	0	0.00	0	0.00	0	0.00	0	0.00
Total	**20**	**610.28**	**78**	**1,806.56**	**38**	**533.94**	**93**	**1,833.63**
	2015		**2016**		**2017**		**2018**	
Source	**No**	**Installed capacity (MW)**	**No**	**Installed capacity (MW)**	**No**	**Installed capacity (MW)**	**No**	**Installed capacity (MW)**
Hydro	126	2,217.54	388	9,960.00	418	11,096.26	447	11,706.41
Wind	60	2,775.00	106	4,319.83	141	5,395.80	151	6,199.98
Geothermal	14	389.92	20	599.15	29	752.10	37	996.77
Biomass	34	192.95	42	203.71	57	299.96	70	349.21
Solar	0	0.00	0	0.00	2	12.90	3	13.90
Total	**234**	**5,575.41**	**556**	**15,082.69**	**647**	**17,557.02**	**708**	**19,266.27**

Table 5. Expansion of renewable energy power plants and plants under YEKDEM

	2011		2012		2013		2014	
Source	**Installed capacity (MW)**	**Share (%)**	**Installed capacity (MW)**	**Share (%)**	**Installed capacity (MW)**	**Share (%)**	**Installed capacity (MW)**	**Share (%)**
Hydro	17,137.10	0.13	19,609.40	4.95	22,289.00	0.97	23,643.20	2.66
Wind	1,728.70	27.14	2,260.60	30.43	2,759.70	2.75	3,629.70	22.77
Geothermal	114.20	63.35	162.20	44.61	310.80	45.16	404.90	56.27
Biomass	125.70	36.94	168.80	44.62	235.00	43.02	299.10	50.43
Solar	0.00	0.00	0.00	0.00	0.00	0.00	40.20	0.00
Total	19,105.70	3.19	22,201.00	8.14	25,594.50	2.09	28,017.10	6.54
	2015		**2016**		**2017**		**2018**	
Source	**Installed capacity (MW)**	**Share (%)**	**Installed capacity (MW)**	**Share (%)**	**Installed capacity (MW)**	**Share (%)**	**Installed capacity (MW)**	**Share (%)**
Hydro	25,867.80	8.57	26,681.10	37.33	27,273.10	40.69	28,238.80	41.46
Wind	4,503.20	61.62	5,751.30	75.11	6,516.20	82.81	7,005.40	88.50
Geothermal	623.90	62.50	820.90	72.99	1,063.70	70.71	1,282.50	77.72
Biomass	370.10	52.13	496.40	41.04	575.10	52.16	624.10	55.95
Solar	248.80	0.00	832.50	0.00	3,420.70	0.38	5,062.90	0.27
Total	31,613.80	17.64	34,582.20	43.61	38,848.80	45.19	42,213.70	45.64

In parallel with the advancements in renewable energy technologies and the increase of the share of renewable power plants within the energy mix of Turkey, local industry also developed and the production of local-contents have become more widespread. The share of plants receiving bonus tariff for local-contents in the 2014-2018 period within all renewable plants is given in Table 6 [28].

In 2014, the share of plants receiving bonus for local-contents within a total of 93 plants under YEKDEM was 16%. This share saw an increase in 2018 and 18% of 708 plants under YEKDEM enjoyed local-content bonus at different rates. Wind power plants were the prominent plants in terms of receiving support for local-contents. Wind power plants are followed by geothermal power plants. There were some PV power plants receiving bonus for local-contents from 2018 onwards [28]. Within the 2014-2018 period, all renewable power plants were able to avail of bonus for local-contents at certain rates.

In Table 7, the maximum local-contents contribution rates available which vary per source and the rates of maximum benefit from local-contents contribution per source are given.

Table 6. Share of plants receiving local-content bonus

	Share of plants (%)				
Source	**2014**	**2015**	**2016**	**2017**	**2018**
Hydro	3	3	2	3	3
Wind	67	52	48	55	59
Geothermal	0	0	15	24	46
Biomass	0	0	2	5	7
Solar	0	0	0	0	33
Total	16	15	11	15	18

Table 7. Rates of benefit from local-content bonus

Source	**Max. Avaible local- content bonus (USD cent/kWh)**	**Max. local- content bonus (USD cent/kWh)**					**Rate of max. benefit from the bonus for 2018 (%)**
		2014	**2015**	**2016**	**2017**	**2018**	
Hydro	2.30	2.00	2.00	2.00	2.00	2.00	86.96
Wind	3.70	1.40	1.40	1.40	1.40	1.40	37.84
Geothermal	2.7	0.00	0.00	1.30	1.30	1.30	48.15
Biomass	5.6	0.00	0.00	0.60	0.68	1.70	30.36
Solar (PV)	6.7	0.00	0.00	0.00	0.00	0.44	6.57

According to the data in Table 7, HPPs, which are being used for a long time and which are rather dominant among the renewable energy technologies in Turkey, are the power plants which have received the highest amount of local-content bonus. Geothermal power plants are second in line to these plants. Local-content bonus has been rendered available for all technologies as of 2018 [28].

3. YEKA AUCTIONS IN TURKEY AND AUCTION DESIGN CRITERIA

Before implementing auctions, different RES incentive mechanisms adopted in Turkey. Renewable energy law enacted in 2005 and the FiT mechanism started to be utilized. Another incentive policy Turkey carried out before the YEKA auctions is the pre-licensing tenders prepared between 2013 and 2017 for wind and PV power plants [29].

YEKA regulation was issued in 2016, and following the amendment made in the regulation in 2017, it became possible to carry out YEKA auctions. Within this scope, two YEKA auctions (YEKA-1 solar and YEKA-1 wind) were carried out in 2017 with a capacity of 1 GW each, one for onshore wind and one for PV. In may 2019, second wind auction for 1 GW (YEKA-2 wind) was completed. YEKA auctions in Turkey are carried out in four stages. These stages are; identification of source zones, tender and earning the renewable energy source zone rights, licensing and energy sales [30].

Determination of auction design criteria can vary depending on national policy targets, the status of RES technologies in the competitive market environment as well as national legal structures [19]. A renewable energy auction with well-defined design criteria in a fully competitive environment helps to achieve renewable energy targets in a cost-effective and transparent way [31]. Important criteria during auction design emerge as a result of work concerning; regulations on the demand side, determination of pre-qualifications, determination of winner selection criteria and determination of liabilities [32].

3.1. Demand-side Regulations

Demand-side regulations are carried out through arrangements on such issues as the transparency, scope, volume and frequency of the auction as well as the selection of technologies.

Responsible to ensure that energy policy targets have been achieved, the auction authority shall also be responsible to see that the auction has been carried out in a transparent way. This authority shall make no decisions that contradict energy policy targets, which shall play an active role during the design of the auction [31,33]. MENR is the responsible authority to determine the design criteria for YEKA auctions in Turkey, to announce the tender as well as to prepare specifications [34].

Policy targets of auctions have to be clearly defined and targets determined shall be a part of the comprehensive RES strategy. In view of improving RES, policy makers shall focus develop long-term (next 10 years) and short-term (next 2-3 years) plans indicating targeted installed capacity and/or generation. Plans to be developed shall be in harmony with national guarantees, climate change policies and the national legal system [17,31,33].

Auction volume is a critical factor that has an impact on competition during the tender process. Auction volume can be identified either in terms of installed capacity (MW) or energy (MWh) [14,17]. Auction volume defined in terms of installed capacity is the mostly widely used auction volume determinant [17]. Announcement of the auction volume before the tender increases competition [14,17,32]. YEKA auctions carried out in Turkey are capacity-based auctions the volumes of which are announced before the tender. Volumes of YEKA auction in Turkey and number of tenders are given in Table 8 [35-44].

Table 8. YEKA auction volumes and number of tenders

Auction	Volume (MW)	No. of tenders
YEKA-1 Solar	1,000	1
YEKA-1 Wind	1,000	1
YEKA-2 Solar	500+300+200	3
YEKA-2 Wind	4*250	4
YEKA-1 Offshore	1,200	1

YEKA-1 solar, YEKA-1 wind and YEKA-1 offshore wind auctions have been designed as single-product, single-unit and large volume tenders. Then, YEKA-2 solar and YEKA-2 wind auctions are single-product, multi-unit and large volume tenders.

Auctions planned for the long-term that will be out at regular intervals give various investors inside the value chain the chance to make long-term plans and adjust their expectations accordingly. This reduces investor's risk, augments competition, improves financial conditions and reduces the costs [12,14,17,32]. Auctions carried out in Turkey are not the result of an extended long-term planning.

Choice of technology is yet another criterion that affects the outcome for the auction. Technologies included in the scope of the auction and how these technologies compete are determined with a consideration for many issues including energy policies, cost, diversity of resources, energy supply security and environmental impacts[18]. There are three auction models whereby three technology criteria have been determined; technology-specific, multi-technology and technology-neutral [14,17,19]. Technology-specific auctions can be initially carried out to support RES. Then, when technology-specific auction practices are well-established, technology-neutral auction procedures can follow for full competition

[18,33]. YEKA auctions carried out in Turkey are designed as technology-specific.

3.2. Pre-qualification Criteria

Pre-qualification criteria cover such regulations as the requirements to be met by auction participants, the quality of the institution carrying out the auction, penalties, company recognition, technical and financial qualifications, identification of the investment zone, grid connection arrangement and incentives for socioeconomic development, etc. [33].

During the determination of pre-conditions required for participating in the tender the project processes have to be facilitated with a concern not to reduce the variety nor the number of bidders through suffocating conditionalities [14,16]. Previous projects by participating companies, company recognition and their technical and legal capacities, and such conditions as obtaining environmental permits, management capacity, partnership structure and local-content regulations can be included among technical qualification criteria [14,16,31,32]. Financial qualifications concern qualifications which are related to the bidder's provision for a financial guarantee [16].

Conditions to work with a local partner and submit job-completion certificate have been included in YEKA-1 solar and YEKA-1 wind auctions. These conditions are not applied for announced auctions [35,37,39,41,43].

Financial qualification criteria include provisional guarantee and job-completion guarantee as part of auction design criteria [45,46]. Guarantee applies to all of the YEKA auctions carried out in Turkey. Provisional guarantee is sought during the tender application stage and job-completion guarantee is sought in the post-signature stage [39,41]. Financial qualification criteria for YEKA auctions in Turkey are given in Table 9 [35,37,39,41,43].

In order to ensure that latest technologies and quality equipment are used, criteria regarding the technologies and equipment to be used in such auctions can be determined [32]. In order to encourage use of modern technologies and quality equipment in the design of YEKA auctions in Turkey, technological criteria for equipment to be used in plants have been determined [36,40].

Investment sites can be identified by public authority or by the investor. In cases where the site has been identified by the public authority grid stability is ensured, investment risks are reduced, tender price drops and the investment completion duration is curtailed [46]. In initial practices of the auction mechanism, identification of the investment site by the public authority is recommended [33].

There are two methods used for transferring the right of use of YEKA's. These methods are; Allocation on the condition of using local-content (YMKT) and Allocation on the condition of local production (YÜKT) methods. In YMKT, the legal person committing to use local-contents in renewable power plants is allocated with the right of use for the YEKA. In YÜKT , the legal person, who produces and/or who commits to produce the parts used in renewable power plants, is allocated with the right of use for the YEKA [30].

Investment site can be selected, either by the public authority or the investor [37]. Site in YEKA-1 solar auction, has been developed by the public authority (MENR) and site in YEKA-1 wind auction has been selected by the investor [35,37,39,41,43].

Investments to be made in relation with the grid-integration of renewable energy investments will affect investment cost as well as competition. System use permits and such investments as grid extension and reinforcement are also determined within this framework [32]. Cost to be incurred in relation with the grid can be borne by the investor or the system operator or jointly. Three different models have been developed depending on the payment of the system use fee and by which of the parties the investment is to be made [14]. Investments for energy transmission facilities needed for YEKA generation plants shall be carried out by Turkish Electricity Transmission Company (TEİAŞ) [34].

Auction design criteria can serve to develop regulations seeking to improve local industry, local welfare and local employment [32,46]. YEKA auctions for wind and solar also seek to strengthen local industry. YEKA auctions include conditions for Research and Development (R&D) activities and local-content regulations. Improvement of local industry and production of high value-added products have been targeted and regulations were made for this purpose. For this purpose, YÜKT method was used for YEKA-1 solar and YEKA-1 wind auctions. Moreover, the auctions have an obligation regarding the establishment of R&D centers. YEKA-2 solar, YEKA-2 wind and YEKA-1 offshore wind auctions shall utilize YMKT method. Socio-economic benefits of YEKA auction are presented in Table 10.

3.3. Determining the Winner Selection Criteria

The phase of determining the selection criteria for the winner encompasses the arrangements to be made with regard to the tender method, the price which the winning bidder shall avail and the ceiling price.

The hybrid tender method where in a closed bid is followed by a reverse auction is a widely adopted method [14,31]. For the first implementation of renewable energy tenders, the utilization of the first-price closed-bid method is recommended. As the market develops and further specialization is gained, more diverse tender methods may be preferred [33]. Turkey uses a hybrid type of auction. This describes an auction where the first phase operates as a pay-as-bid sealed-bid

auction then the second phase operates as a reverse auction. The price of the RES-E is defined in multi-round bids. While determining the amount of contribution, the adoption of the pay-as-bid method is recommended due to its simplicity [33]. In the YEKA tenders carried out in Turkey, the pay-as-bid method is adopted. The ceiling

price is the highest price that can be bade in tenders. Bids which exceed such price are eliminated from the tender. The practice of setting a ceiling price increases the potential for the control of policy costs and prevents making high profits in tenders with limited competition. A duly determined ceiling price would enable the placement of correct bids [14,17,32].

Table 9. YEKA financial qualification criteria

Auction	Specification fee (Thousand TRY)	Provisional guarantee fee (million USD)	Duration for the provisional guarantee (Year)	Job completion guarantee (million USD)	Duration for the job completion guarantee (Year)
YEKA-1 Solar	10	10	1	50	10
YEKA-1 Wind	20	10	1	50	20
YEKA-2 Solar	5	3 (Viranşehir) 1,5 (Erzin) 2 (Bor)	1	15 (Viranşehir) 8 (Erzin) 12 (Bor)	10
YEKA-2 Wind	5	2.5	1	12.5	10
YEKA-1 Offshore Wind	20	20	1	100	10

Table 10. Socio-economic benefits of YEKA auctions

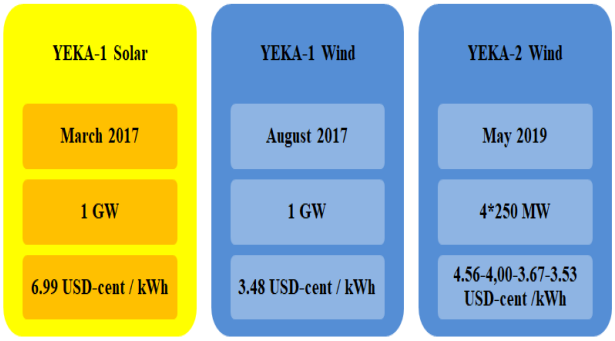
Auction	Method used in the transfer of right of use	Factory establishment obligation	R&D centre establishment obligation	Min. local- content share (%)
YEKA-1 Solar	YÜKT	Yes	Yes	70
YEKA-1 Wind	YÜKT	Yes	Yes	65
YEKA-2 Solar	YMKT	No	No	60
YEKA-2 Wind	YMKT	No	No	55
YEKA-1 Offshore Wind	YMKT	No	No	55

The ceiling price practice is recommended for the first implementation of capacity-based tenders containing restricted amounts [33]. The pre-disclosure of the ceiling price is a positive practice which allows for investors to plan accordingly beforehand [17]. In auctions carried out in Turkey, the practice of pre-disclosing the ceiling price is adopted. Such ceiling price is set and pre-disclosed by the MENR. YEKDEM prices are taken as basis in setting the ceiling price [34]. The ceiling price for the YEKA-1 solar tender was determined as 8.00 USD cent/kWh, and 6.50 USD cent/kWh for YEKA-2 solar tender [35,39]. The ceiling price for the YEKA-1 wind power tender was determined as 7.00 USD cent/kWh, and 5.50 USD cent/kWh for YEKA-2 wind tender. The ceiling price for YEKA-1 offshore wind tender was determined as 8.00 USD cent/kWh [37,41,43]. In 2017, two large-scale single-product, single-unit YEKA auctions with a capacity of 1 GW were carried out. Both of the tenders were won by two separate consortiums made up of national and international partners. Prices remaining below the global average were present in tenders and the winning price for the YEKA-1 solar tender was 6.99 USD cent/kWh and 3.48 USD cent/kWh for the YEKA-1 Wind tender. Figure 2 provides the date of tenders, volumes, and prices of the winning bids of auctions that have been held so far.

3.4. Determining the Liabilities

Obligations include the obligations of both parties which invite and win the tender and aim to reduce the risks for bidders and those who carry out the tender. Issues such as clearly defining the auction and contract processes and determining what penalties will be inflicted in cases of deferment should be taken care of before the auction process. Whether the price to be paid shall be fixed or not and if it is indexed to inflation or another rate or if it shall change in accordance with the market prices should be determined [44].

Figure 2. The date of tenders, volumes and the prices of the winning bids in Turkey



In renewable energy auctions, measures need to be taken in order to alleviate the investor's risk perception and a foreseeable market and tendering process should be in place. The trust of investors should be bolstered through adjustments to be made. In order to alleviate investor risks and to establish an environment of trust, investors who plan to invest in the project should be provided with timely and easy access to information and documents which affect their investment decisions. Investment risks may also be diminished through measurements to be taken with a view to decrease the risks brought on by inflation and foreign exchange rates [32]. Practices such as setting definite duration in purchase agreements and indexing the exchange rate in tenders carried out over the domestic currency in order to prevent price escalation diminish the investor risks. The duration of the power purchase agreement is one of the significant parameters which have an effect on the effectivity of the auction mechanism. Having a long power purchase agreement duration decreases the project and financing risks [16].

YEKA auctions carried out in Turkey contain long power purchase agreement duration. The power purchase agreement duration in YEKA-1 solar, YEKA-1 wind, YEKA-2 solar and YEKA-2 wind power auctions is 15 years from the date on which the YEKA right of use agreement is signed [35,37,39,41]. A different approach was adopted for the YEKA-1 offshore wind auction. In this project, the duration for the purchase of electrical energy equals the duration for which the first 50 TWh of energy generated is fed to the system starting from the date on which the first provisional acceptance of the first power plant to be established within this scope [43]. The license period to be granted within the scope of YEKA auctions is 30 years [34].

When determining auction design criteria, measures that will ensure timely completion of the project must be identified [16]. A process for the resolution of disputes which may arise during all stages of the auction must be determined [33]. Penal sanctions which will prevent "Wait and see" approach, must be put into action regarding bidders who cannot fulfill their commitments [14,16]. The penal sanctions should be regulated in order to not prevent participation to the tender, number of participants should not be reduced [16]. Penal sanctions regarding YEKA auction designs in Turkey include practices such as; forfeiting security and collaterals and annulment of renewable energy right of use agreement (cancellation of the procurement guarantee) [34].

4. RESULTS AND DISCUSSION

Turkey is heavily dependent on other countries in terms of fossil fuels and the share of fossil fuels in energy production is significant. When the continuous increase in emissions of the country and the importance of climate change for the world's agenda taken into consideration; the primary solution to the economic, technical and environmental problems, that the fossil fuels cause, is the rich and insufficiently tapped RES of Turkey.

Certain incentive and support mechanisms were carried out in order to utilize the full potential of Turkey's RES and significant increases were observed in Turkey's renewable installed capacity following the amendment in the Renewable Energy Law in 2010. FiT mechanism has driven rapid growth in renewable electricity markets and promoted manufacturing industries. As a result of price guarantees and local-content provide provided within the scope of YEKDEM, local industry has grown and employment rate in energy market has increased [47]. Despite these positive developments, utilization of the potential of renewable energy and attainment of the determined policy goals remained insufficient. As of the end of 2018, Turkey has only tapped into 31% of its renewable energy potential. With the exception of geothermal power plants, take-up of other RES other than hydro sources is still low. Usage of wind and solar potential is as a low level as 15% and 10% respectively. When 2023 goals are taken into consideration, solar and geothermal capacities seem to have reached the targeted values. The achievement rates of hydro and Biomass are 83% and 74% respectively. This rate is 35% for wind power. Both the utilization and the attainment rates of wind remain low.

A certain level of local production rate was achieved for some parts of PV modules and wind turbines. Local-content usage rate in renewable energy-based power plants being set as 45% as of 2019 in MENR 2015-2019 strategic plan, shows that the local industry must improve. Based on the minimum local-content rates in YEKA auctions carried out and planned to be carried out, it can be stated that the local-content rate in solar and wind power production technologies is 50% on average. It is important to provide this local-content production rate with high added value component parts. In this context, high added value (solar cell, wind generator etc.) local component parts should be produced. First renewable energy auctions carried out were correct regarding the production of high value added component. R&D centers planned to be established within the scope of first YEKA auctions shall facilitate the local production of high added value technologies.

The auction mechanism, using other incentive methods, should be more effective when the renewable energy

goals set forth by the governments are met and when the renewable energy technologies develop to a certain point [31]. It is observed that low prices in latest renewable energy auctions across the world are prepared via low cost financing, appropriate political environment and well-designed auction models [8]. When evaluated in this context, it is observed that some setbacks have occurred in relation to reaching the policy targets set by the Republic of Turkey government. Licensed wind investments were delayed and hydro targets were overhauled. Annulments and ambiguities have occurred in YEKA auctions. Annulments and postponements were not explained with concrete reasons. The annulments and postponements in YEKA auctions occurred due to the increase in financing costs as a result of economic and political fluctuations. Targeted goal was not reached in investment and a change has occurred in the partnership structure of the business partnership which was awarded the YEKA-1 Solar auction.

Within this scope, along with price criteria, the mechanism has pre-qualification criteria and local production and local-content use conditions. The energy procurement durations are sufficient and have criteria to support socio-economic growth. Because of these specifications, it has a hybrid characteristic where all intended uses [12,13,31] in the literature are practiced together. Hybrid auction model, practiced by combining positive aspects of auction methods, is widely preferred [18]. The hybrid auction model used in Turkey is in line with other practices used around the globe. It does not just aim to increase installed capacity or reduce costs. Auction design criteria have in general a positive structure. However, financing costs are high and there is no reassuring political atmosphere at the moment. Similar to other practices in the world [8], as a result of the YEKA auctions in Turkey, support prices were decreased. Following tenders, prices have decreased about 50% of YEKDEM prices.

To provide transparency and competitive conditions; in order to ensure as much participation in the tender and also an effectively competitive environment, tender participants shall be granted some time so that they can satisfy the requirements to participate [31,33]. Adequate duration is provided in Turkey regarding this matter.

Capacity-based tender volume practice, which is widely used for determining the volume of the auction, [14,17,33] is practiced for auctions in Turkey and announced by being set before the tender. A one-off tender with a high volume favors a fast development of novel technologies however it can also reduce competition and lead to bloated prices [14,17,32]. In YEKA-1 solar and YEKA-1 wind auctions, large volumes auctioned at once. However, number of participants was high and competitive conditions were met and a price close to 50% of YEKDEM support prices was emerged. In line with the practices in the literature [16,17]; the auction authority uses FiT prices as a reference for setting the ceiling price.

Contrary to literature [12,14,17,32], past and future YEKA tenders lack long-term planning with no regular frequency.

Turkey practices technology specific tender method in line with the literature [14, 19]. Determined criteria regarding technical and financial competences are sufficient. Minimum local production rate and component-based local-content rates within auction criteria, are positive practices in terms of supporting socio-economic growth.

In line with the literature [14,17,33,32], pre-announced ceiling price practice, which is suggested to be carried out when conducting capacity based amount limited tenders for the first time, is being used. In first YEKA auctions (YEKA-1 Solar and YEKA-1 wind) YEKDEM prices were used as the ceiling price. In following tenders, ceiling prices, number of participants and bids on each round were taken into consideration to update the ceiling prices. This practice is in line with the literature [16,17]. In line with the literature [16,32] measures, which shall increase investor trust, were taken. Long term electricity procurement guarantee and support price based on dollar exchange rate methods are available. However there are political stability and financing cost problems. System operator model was adopted for YEKA auctions in Turkey [14]. TEİAŞ is responsible for investments for energy transfer line/transformer plant required between switching stations and connection points, being done in a timely manner and for carrying out operation and maintenance activities [38,40]. System operator is an experienced institution and this duty being bestowed on it shall provide an important advantage which will prevent grid related delays [13].

5. RECOMMENDATIONS

Utilization rate of renewable energy potential and attainment rate of determined policy targets are low in Turkey. Turkey should use more of its abundant RES, and primarily the installed capacity share of Wind and Solar Power Plants have to be increased.

Renewable technology costs decreased and developments in local production of solar and wind technologies were observed. FiTs determined in 2010 are now too high. YEKDEM should be carried on with updated FiTs. With well-built auction design criteria, YEKA auctions may contribute to the increase in renewable installed capacity. This mechanism is not alone enough to reach political goals and should be used with other supportive regulations. For this purpose, YEKDEM should continue with updated tariffs and solar and wind tender practice should carry on. Within the scope of long-term plans, YEKA auctions with determined frequency should be carried out. For a sustainable energy sector, investments should be made on the announced dates. Detailed explanations regarding the timelines and volume of the tenders should be made in relation to the determined installed capacity shares.

First YEKA auctions should contribute to rapid evaluation of renewable energy potential, which is not being used sufficiently and increase our capacity to produce high added value components in R&D centers to be built.

YEKA auctions to be carried out should be smaller and spread out more geographically. Single - product multi-unit auctions should facilitate financing and increase competitive environment. Date and size of the tenders should be determined beforehand and alterations should not be made on the published calendar. With global competition taken into consideration, investments should be carried out on YMKT condition.

DECLARATION OF ETHICAL STANDARDS

The author of this article declares that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

AUTHORS' CONTRIBUTIONS

Mustafa OZCAN: Performed the study, analysed the results and wrote the manuscript.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

REFERENCES

[1] Bulut, U. Muratoglu, G, "Renewable Energy in Turkey: Great Potential, Low but Increasing Utilization, and an Empirical Analysis on Renewable Energy-Growth nexus", ***Energy Policy,*** 123:240-250, (2018).

[2] Polzin, F. Egli, F. Steffen, B. Schmidt, T.S., "How do policies mobilize private finance for renewable energy?—A systematic review with an investor perspective", ***Applied Energy***, 236:1249-1268, (2019).

[3] Mihaylov, M. Radulescu, R. Razo-Zapata, I. Jurado, S. Arco, L. Avellana, N. Nowe, A., "Comparing stakeholder incentives across state-of-the-art renewable support mechanisms", ***Renewable Energy***, 131:689-699, (2019).

[4] Abu Hamed, T. Bressler, L., "Energy security in Israel and Jordan: The role of renewable energy sources", ***Renewable Energy***, 135:378-389,(2019).

[5] Dolf, G. Francisco, B. Deger, S. Morgan D. B. Nicholas, W. Ricardo, G., "The role of renewable energy transformation", **Energy Strategy Reviews**, 24:38-50, (2019).

[6] Tiago, A.L. António, C.M. José, A.F., "Strategies to make renewable energy sources compatible with economic growth", ***Energy Strategy Reviews***, 18:121-126,(2017).

[7] BP (British Petroleum). BP Energy Outlook 2019. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/energy-outlook/bp-energy-outlook-2019.pdf (accessed 26 March 2019).

[8] IRENA (International Renewable Energy Agency). Renewable Power Generation Costs, Abu Dhabi, (2017).

[9] Lazard. Selected Historical Mean Unsubsidized LCOE Values, Lazard's levelized cost of energy analysis - version,12.0. https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf (accessed 13 March 2019).

[10] Bloomberg NEF. Turkey Long-term Power Market Outlook, November 2 , (2018).

[11] Grashof, K., "Are auctions likely to deter community wind projects? And would this be problematic?", ***Energy Policy***, 125: 20-32, (2019).

[12] Del Río, P. Mir-Artigues, P., "Designing auctions for concentrating solar power", ***Energy for Sustainable Development***, 48:67-81, (2019).

[13] Bayer, B. Schäuble, D. Ferrari, M., "International experiences with tender procedures for renewable energy - A comparison of current developments in Brazil, France, Italy and South Africa", ***Renewable and Sustainable Energy Reviews***, 95: 305-327,(2018).

[14] Renewable auction design in theory and practice: lessons from the experinces of Brazil and Mexico. ***Oxford Institute for Energy Studies***, OIES Paper El 28.

[15] Shivakumar, A. Dobbins, A. Fahl, U. Singh, A., "Drivers of renewable energy deployment in the EU: An analysis of past trends and projections", ***Energy Strategy Reviews***, 26: 100-402, (2019).

[16] AURES (Promoting effective renewable energy auctions). Recommendations on the role of auctions in a new renewable energy directive. (2016).

[17] AURES (Promoting effective renewable energy auctions). Auctions for renewable energy support - Taming the beast of competitive bidding. ***Final report of the AURES Project***, Report D9, (2017).

[18] IBRD-WB (The International Bank for Reconstruction and Development/The World Bank). Electricity Auctions: An Overview of Efficient Practices, (2011).

[19] CEER (The Council of European Energy Regulators). Tendering procedures for RES in Europe: State of play and first lessons learnt, (2018).

[20] FS-UNEP (Frankfurt School of Finance & Management,Centre for Climate and Sustainable Energy Finance). Global trends in renewable energy investment, (2018).

[21] Ozcan, M., "The role of renewables in increasing Turkey's self-sufficiency in electrical Energy", ***Renewable and Sustainable Energy Reviews***, 82: 2629-2639, (2018).

[22] Topcu, I. Ülengin, F. Kabak, Ö. Isik, M. Unver, B. Ekici, S.O., "The evaluation of electricity generation resources: The case of Turkey", ***Energy***, 167: 417-427, (2019).

[23] Argin, M. Yerci, V. Erdogan, N. Kucuksari, S. Cali, U., "Exploring the offshore wind energy potential of Turkey based on multi-criteria site selection", ***Energy Strategy Reviews***, 23: 33-46, (2019).

[24] https://www.teias.gov.tr/sites/default/files/2019-01/kurulu_guc_aralik_2018.pdf, "TEİAŞ (Turkish Electricity Transmission Company)-Turkey electricity system installed capacity based on structure and resources, (08 February 2019).

[25] Melikoglu, M., "Vision 2023: Scrutinizing achievability of Turkey's electricity capacity targets and generating scenario based nationwide electricity demand forecasts", ***Energy Strategy Reviews***, 22: 188-195, (2018).

[26] https://www.teias.gov.tr/tr/i-kurulu-guc, "Development of Installed Renewable Energy Shares in Turkey's Total Energy Production Based on Years (2000-2016)" , (08 February 2019).

[27] https://www.tureb.com.tr/files/bilgi_bankasi/turkiye_res_durumu/istatistik_raporu_ocak_2019.pdf, "Turkish

Wind Energy Association (TÜREB). Turkish wind energy statistic report 2019", (30 February 2019).
[28] http://www.epdk.org.tr/Detay/Icerik/3-0-72/elektrikyekdem, "EMRA (Republic of Turkey Energy Market Regulatory Authority)- Electricity Market YEKDEM List", (08 January 2019).
[29] https://www.epdk.org.tr/Detay/Icerik/3-0-39-3/kurul-kararlari-, "EMRA (Republic of Turkey Energy Market Regulatory Authority)- Electricity Market List of Board Decisions, (22 February 2019).
[30] MENR (Republic of Turkey Ministry of Energy and Natural Resources). YEKA Guideline for Wind Investors, (2017).
[31] USAID (U.S. Agency for International Development Regional Development Mission for Asia). Designing renewable energy incentives and auctions: Lessons for Asean, (2017).
[32] IRENA-CEM (International Renewable Energy Agency - The Clean Energy Ministerial). Renewable Energy Auctions - A Guide to Design,(2015).
[33] EBRD- IRENA (European Bank for Reconstruction and Development - International Renewable Energy Agency). Policy Guidelines on Competitive Selection and Support for Renewable Energy, (2018).
[34] https://www.resmigazete.gov.tr/eskiler/2016/10/20161009-1.htm, "Yenilenebilir Enerji Kaynak Alanları Yönetmeliği-Renewable energy source zone regulation", (19 May 2020).
[35] https://www.resmigazete.gov.tr/ilanlar/eskiilanlar/2016/10/20161020-4.htm#%C3%8703, Karapınar Yenilenebilir Enerji Kaynak Alanı (YEKA) Yurt İçinde Üretim Karşılığı Tahsisi (YÜKT) Yarışma İlanı - Karapınar YEKA Tender Announcement", (19 May 2020).
[36] YEKA-1 solar specification.
[37] https://www.resmigazete.gov.tr/ilanlar/eskiilanlar/2017/04/20170413-4.htm # % C3 % A703, Rüzgar Enerjisi Yenilenebilir Enerji Kaynak Alanları Ve Bağlantı Kapasitelerinin Tahsisine İlişkin Yarışma İlanı - Tender announcement regarding wind power renewable energy source zones and connection capacity allocation , (19 May 2020).
[38] YEKA-1 onshore wind specification
[39] https://www.resmigazete.gov.tr/ilanlar/eskiilanlar/2018/10/20181005-4.htm#%C3%8705, Güneş Enerjisine Dayalı Yenilenebilir Enerji Kaynak Alanları Ve Bağlantı Kapasitelerinin Tahsisine İlişkin Yarışma İlanı - Tender announcement regarding solar power renewable energy source zones and connection capacity allocation, (19 May 2020).
[40] YEKA-2 solar specifications
[41] https://www.resmigazete.gov.tr/ilanlar/eskiilanlar/2018/11/20181107-4%20(16).pdf, "Rüzgar Enerjisine Dayalı Yenilenebilir Kaynak Alanları ve Bağlantı Kapasitelerinin Tahsisine İlişkin Yarışma İlanı - Tender announcement regarding wind power renewable energy source zones and connection capacity allocation", (19 May 2020).
[42] YEKA-2 onshore wind specification.
[43] https://www.resmigazete.gov.tr/ilanlar/eskiilanlar/2018/06/20180621-4.htm#%C3%8702,"Rüzgâr Enerjisine Dayalı Deniz Üstü (Offshore) Yenilenebilir Enerji Kaynak Alanları Ve Bağlantı Kapasitelerinin Tahsisine İlişkin Yarışma İlanı - Tender announcement regarding offshore wind power renewable energy source zones and connection capacity allocation", (19 May 2020).
[44] YEKA-1 offshore wind specification.
[45] IRENA (International Renewable Energy Agency). Renewable Energy Auctions: Analysing 2016, Abu Dhabi, (2016).
[46] MIR (Management Programme in Infrastructure Reform and Regulation). Renewable energy auctions: A Global Overview, Report 1: Energy and Economic Growth Research Programme, PO Number: PO00022908, 2018.
[47] IRENA (International Renewable Energy Agency). Renewable Energy and Jobs Annual Review 2018, (2018).