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İZMİR KÂTİP ÇELEBİ ÜNİVERSİTESİ

AN ANALYSIS OF SYSTEMATIC RISK FACTORS ASSOCIATED WITH RENEWABLE ENERGY SUPPORT MECHANISM APPLIED IN TURKEY

TÜRKİYE'DE UYGULANAN YENİLENEBİLİR ENERJİ KAYNAKLARINI DESTEKLEME MEKANİZMASINA İLİŞKİN SİSTEMATİK RİSK FAKTÖRLERİNİN ANALİZİ

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ÖZET

Türkiye'de yenilenebilir enerji kaynaklarından üretilen elektrik, ilgili tesise bağlı olarak ABD Doları veya Türk Lirası (TL) cinsinden sabit bir tarife ile desteklenmekte ve faydalanıcı şirkete TL cinsinden ödeme yapılmaktadır. Bu makalede, Türkiye'deki destek mekanizması (RESUM)'na ilişkin sistematik riskler, her bir paydaşa yönelik nakit akımı kullanılarak incelenmiştir. Çalışmada yenilenebilir enerjiye dayalı elektrik üretimindeki artışın; klasik enerji santrallerinin daha az yük almasına, piyasa fiyatlarında düşüşe ve eksik para sorununa yol açtığı kaydedilmiştir. Üretim kesintisi sistem işletmecisi için risk oluşturmakta ve yedek kapasite ihtiyacını artırmaktadır. RESUM'un tüm maliyeti bir şekilde tüketicilere yansıtılmaktadır. Yürürlükteki düzenlemelere göre tüketiciler üzerindeki risk, döviz kuru ve enflasyondaki belirsizlikten kaynaklanmaktadır. Döviz kuru, enflasyon ve yenilenebilir enerji üretimindeki değişiklikler tedarikçiler üzerinde fiyat riski oluşturmaktadır. Çalışmada söz konusu risk faktörleri için önerilerde bulunulmuştur.

Anahtar Kelimeler: Yenilenebilir enerji destekleme mekanizması, elektrik piyasası, sistematik risk, sabit fiyat, Türkiye
JEL Kodları: Q40, Q43, Q48, L50

ABSTACT

Electricity generated from renewable energy resources in Turkey is supported by feed-in tariff in US dollars or Turkish Lira (TL), depending on the power plant concerned and the payment is made to the beneficiary company in TL. The systematic risks associated with the support mechanism in Turkey (RESUM) were analyzed in this study, using cash flows for each stakeholder. In this study, it is noted that increasing renewable electricity generation leads to the less dispatch of conventional power plants, lower market prices, and the missing money problem. Generation intermittency poses risks to the system operator and increases the need for reserve capacity. The full cost of RESUM is somehow reflected to consumers. According to current regulations, the risk to consumers stems primarily from the exchange rate volatility and inflation. The exchange rate, inflation, and changes in renewable energy generation pose price risks to suppliers. In the study, recommendations for these risk factors were made.

Keywords: Renewable energy support mechanism, electricity market, systematic risk, feed-in tariff, Turkey
JEL Codes: Q40, Q43, Q48, L50

1. INTRODUCTION

Today, renewable energy resources are given priority in terms of reducing import dependency and increasing environmental awareness as an energy strategy. As stated by Çelikkaya (2017), compared to fossil resources, renewable energy resources are unlimited, environmentally friendly, domestic, and natural resources. These features bring renewable resources to the fore in terms of energy policy. However, relative to traditional generation investments, renewable energy investments have some unique risks. Technologies for renewable energy generation are costly and have not reached the maturity level. It is known that innovative studies are required to develop these technologies and reduce generation costs, and this will certainly take time (Akdağ and Gözen, 2019). On the other hand, as stated by Uyanık (2018), electricity generated from these technologies is intermittent and continuity of generation cannot be maintained. This implies that it is difficult for power plants based on renewable energy to compete in the market (Uyanık and Uçkun 2016). Furthermore, the cost of storage technologies should be reduced and their widespread use should be increased for uninterrupted and continuous generation. In view of the negative effects mentioned above, it is compulsory for such investments in energy to be supported by states within the context of different incentive structures and legislation, without leaving them to market conditions (Çelikkaya, 2017; Akdağ and Gözen, 2019).

As Eser and Polat (2015) emphasized, many countries have started to establish various incentive mechanisms in order to benefit more from renewable resources in energy production in recent years. Several regulations have been put in place to meet the increasing energy need for domestic and renewable resources, especially in high energy demand countries (Bayraktar and Kaya, 2016). These regulations mainly cover the country targets and support methods for the use of renewable energy. According to Akdağ and Gözen (2020), These supporting instruments can be categorized as regulatory models, business models, financial incentives and other public supports. Furthermore, regulatory models can also be grouped under five headings, such as fixed price guarantee, premium guarantee, green certificate, auction, and meter-based design. Project financing, third party participation, energy cooperatives, equity-based crowdfunding, green bonds, and renewable energy funds are examples of business models. Financial incentives and other public supports, among other things, include investment tax cuts, energy sales tax cuts, direct payments for power generation, loans, grants, subsidies, and discounts on various topics.

Turkey has made significant strides in the penetration of renewable energy over the last decade. The renewable energy support mechanism (*RESUM*), which was enacted in 2005, certainly plays the most important role in this development (E-Mevzuat, 2019). Even the legal framework was in effect, the actual implementation of RESUM began in December 2011 because of significant developments achieved in organized electricity markets in Turkey. No generation company applied to enjoy the support mechanism until December 2011 due to relatively higher electricity market prices in organized wholesale markets (EPDK, 2019a). Within RESUM, feed-in tariff is designed to promote electricity generation from renewable energy sources and set in the US dollar (*USD*) in the renewable energy support law no. 5346 (*The Law No. 5346*), but the payment of the support amount in Turkish Lira (*TL*). As a voluntary mechanism, RESUM gives producers the opportunity to take advantage of free market opportunities in the electricity market without entering RESUM or to avoid market risks by participating in RESUM. RESUM also guarantees generators to obtain fixed revenue for the electricity injected to the grid.

In the early years of implementation, some generators preferred to benefit from RESUM, and others preferred to sell their energy at market prices because feed-in prices were close to or lower than spot market prices. However, this balance has begun to deteriorate starting from 2015 due to increase in the US dollar exchange rate against TL and low electricity market prices, and almost all eligible power plants have been included in RESUM since the beginning of 2016 (EPDK, 2019a). With the growth of the RESUM portfolio, the increases in energy imbalance costs and problems related to the balancing mechanism have been largely eliminated with the revision of the secondary legislation, Electricity Market Balancing and Settlement Regulation (*BS Regulation*) realized in May 2016 (EPDK, 2019b). Therefore, the risks related to the system operation have been largely eliminated and the full integration of renewable based power plants into the wholesale market has been ensured. Since feed-in prices are determined by the Law No. 5346, the continuous increase in the US dollar exchange rate against TL leads to further growth of the risk to market participants and consumers. On the other hand, the feed-in price for power plants, which will be in operation after 30 June 2021, is set in TL kuruş by the Presidential Decree No. 3453 (Resmi Gazete, 2021).

No study has been identified on the systemic risk factors associated with RESUM applied in Turkey. However, a study by Kul et al. (2020) emphasizes that the most significant investment risk factors for renewable energy investments in Turkey are economic and business risks. On the other hand, feed-in tariffs expose investors to less market risk, according to a study by Kitzing (2014). Kitzing and Weber (2015) also find that the support levels needed for a German offshore wind park to provide sufficient investment incentives are approximately 4-10 percent lower for a feed-in tariff mechanism than for a feed-in premium mechanism.

This paper used the publicly available data which were published by Turkey's electricity transmission company (*TEIAS*) and Energy Markets Operation Company (*EPIAS*), the transmission system operator and energy exchange company respectively. Total electricity installed capacity of Turkey, annual generation and consumption, and their distribution among sources are published by TEIAS. In addition, various data about wholesale electricity markets are accessible on EPIAS Transparency Platform. In this paper, only systematic risk factors are considered. The systemic risks to stakeholders in the electricity market within the framework of RESUM were addressed in different aspects. Systematic risk is defined as undiversifiable risk or market risk affecting the overall market and this type of risk is both unpredictable and impossible to completely avoid (Ramesh, 1987; Stephen and Randolph, 1988). The source of systematic risk could be macro-scale factors such as inflation, fluctuations in exchange rate, changes in interest rates, and economic recession. By definition, systematic risks are risks that affect the entire market and a single company cannot control them.

This paper aims to provide suggestions to energy regulators and policy makers about systematic risk factors associated with RESUM. For this purpose, the second section provides some information about Turkish electricity market. The third section explains RESUM and its functioning in detail. The fourth section covers the developments in RESUM. The fifth section examines the phases of RESUM and the associated systematic risks to the system operator, renewable based electricity generators, conventional electricity generators, suppliers, and consumers. For this purpose, an analytical approach is used that takes into account the cash flow to each stakeholder. The sixth section discusses the results and provides some suggestions to both regulators and policy makers. The seventh and last section summarizes and ends the paper with what has been discussed.

2. A SNAPSHOT ON TURKISH ELECTRICITY MARKET

Turkey has a growing electricity market and, as end of January 2021, the total installed capacity of electricity approached to 96 GW in Turkey (TEİAŞ, 2021). Currently, a state-owned enterprise, EUAS continues to dominate the electricity market with a 22% share in installed capacity basis (TEİAŞ, 2021). In 2001, Turkey decided to liberalize its electricity market, restructure the market, and open it to competition. For this purpose, Electricity Market Law No. 4628 (*The Law No. 4628*) was passed by the Turkish parliament to start a new period in the electricity sector (EPDK, 2003). This was a historically radical development in the sector. The main principles and legal infrastructure of the new market design are adapted from those of the European Union. In order to accelerate the liberalization process, a strategy paper was published by the Turkish government in 2004 aimed at accelerating the liberalization of the electricity market in compliance with the provisions of the Law No. 4628 (ETKB, 2004). Subsequently, in 2009, the government decided to launch a new strategy paper to speed up the liberalization process and to introduce some steps necessary to ensure the security of the electricity supply (ETKB, 2009). In 2013, a new Electricity Market Law No. 6446 (*The Law No. 6446*) was accepted and became in effect (E-Mevzuat, 2013).

By the Law No. 6446, the activities in the electricity market, except for network activities are open to competition under the supervision of, and regulated by EMRA, Turkish energy regulator. The market structure is based on bilateral contracts market complemented by day ahead market, intraday market, and residual balancing market. Regarding network access, a regulated third-party access regime is applied. Network tariffs and sales to captive customers as well as tariffs for last resort customers are regulated by EMRA.

All market activities must be licensed by EMRA with some exemptions. In Turkey, renewable based power plants with a generation license issued by EMRA are supported by feed-in tariff depending on source and technology. In addition, an extra premium is added to feed-in price for electricity for the use of locally manufactured equipment in Turkey. According to the Law No. 5346, renewable generation facilities with the certificate issued by EMRA may enter the support mechanism. However, EMRA does not issue a separate certificate, but instead a generation license is accepted as a certificate (E-Mevzuat, 2019).

Renewable power plants up to 5 MW, micro-cogeneration facilities up to 100 kW, cogeneration facilities with above certain efficiency values determined by the Ministry of Energy and Natural Resources, generation facilities for municipal waste disposal and treatment facilities, and isolated (*off-grid*) generation are exempted from licensing and establishing companies. Surplus generation from renewable based unlicensed generation facilities is priced at feed-in tariffs. However, the feed-in price for power plants to be commissioned after April 2018 is determined as the retail sales tariff for the subscriber category corresponding to the consumption unit associated with the unlicensed power plant by Decision No. 2018/11837 of the Council of Ministers (EPDK, 2019c).

On March 3, 2003, the first time in the electricity market, eligible customers could select their own suppliers in the market. All customers directly connected to the transmission network as well as consumers with consumption of more than 1.600 kWh per year for 2019 are deemed as eligible customers and the corresponding theoretical degree of market opening on demand side is calculated to be around 95.4% (EPDK; 2018a). The eligible consumer limit has been reduced to 1400 kWh for 2020 and to 1200 kWh for 2021 (EPDK, 2021).

3. THE CHARACTERISTICS AND OPERATION OF RESUM

Turkey' wholesale electricity market consists of bilateral contracts, spot market, and real-time balancing mechanism (EPDK, 2019b). Spot markets are day ahead market (*DAM*) and intraday market (*IDM*), and real-time balancing market which includes balancing power market (*BPM*) and ancillary services market. For the first time in Turkey, following the black-out of the transmission system covering the western part of the country, market based real-time balancing power market were commissioned in 2006 (EPDK, 2019b). From December 2009 to December 2011, day ahead planning had been implemented. Day ahead planning, together with BPM, was operated as a complementary market (EPDK, 2019b).

In December 2011, day ahead planning was replaced by DAM (EPDK, 2019b). Unlike day ahead planning, DAM is a real spot market where market participants trade electrical energy, and which also allows demand side participation. In DAM, prices are simply the values that correspond to the intersection points of supply and demand curves. These prices are called the market clearing price (*MCP*) and are used as a reference price for financial settlement, calculations under RESUM, and even for electricity products traded in financial markets.

IDM was launched in July 2015 to manage imbalances and balance the portfolios between DAM and real-time balancing of market participants (EPDK, 2019b). In Turkey, each participant in the electricity wholesale market is obliged to ensure that its own portfolio is balanced. Each participant causing imbalance in the system must bear the imbalance costs calculated as a result of settlement transactions. On the other hand, IDM offers the opportunity to eliminate imbalances up to 60 minutes before real time, which was initially set at 120 minutes.

Until September 2015, organized wholesale electricity markets and financial settlement transactions were operated by Market Financial Settlement Center (*PMUM*) within TEIAS. EPIAS was established on September 1, 2015 and took over market operation activities from TEIAS. Currently, EPIAS carries out financial settlement transactions associated with DAM and IDM as a market operator. TEIAS is called as the system operator and responsible for the operation of the BPM and ancillary services market to ensure the real-time supply and demand balance in the system.

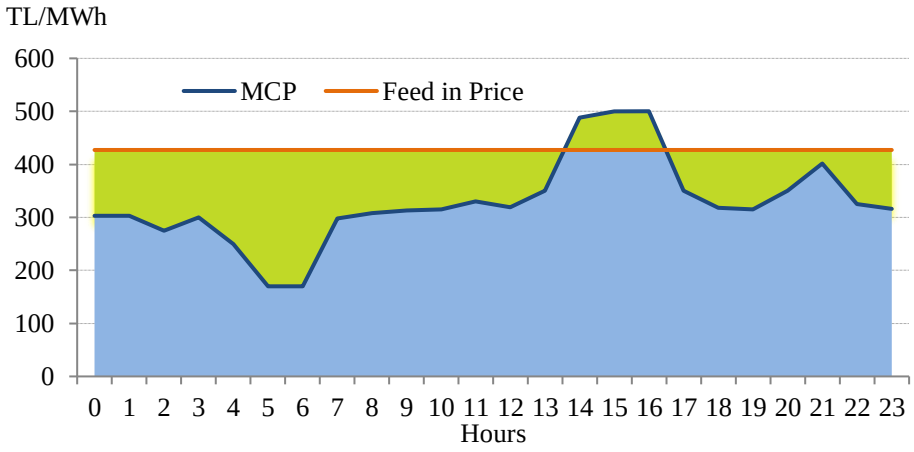
Feed-in prices for the electricity generated from renewable based power plants are guaranteed by the Law No. 5346. For example, for a wind power plant, 7.3 US dollar cents of feed-in price is guaranteed for each kWh of energy injected to the grid (EPDK, 2019a). On the other hand, the implementation of RESUM in the electricity market, including cash flows among RESUM power plants, suppliers, and market operator are regulated by a specific by-law on RESUM approved by EMRA board.

RESUM power plants were not market participants prior to May 2016 and had no responsibility for managing their generation imbalances. They were paid feed-in prices calculated as the amount of energy injected to the grid multiplied by feed-in tariff which is determined by the Law No. 5346. No imbalance cost was charged to RESUM power plants.

By the amendments in the by-law on RESUM (*Regulation on Certification and Support of Renewable Energy Resources*) in April 2016, RESUM participants became directly market participants, meaning that they must supply their generation to the market, manage their generation imbalances, and pay imbalance charges like any other market players (EPDK,

2019a). According to this new methodology, RESUM prices are guaranteed in two stages. First, a RESUM participant power plant sells its electricity to the market. DAM price is taken as a reference price. When a power plant sells its energy to DAM, its revenue is paid on the next day in advance. After the month ends, the differences between DAM prices and feed-in prices are calculated and paid to the power plant owner. This is illustrated graphically in the following drawing (see Fig. 1).

Fig. 1. The differences between DAM prices and feed-in prices, data from EPİAŞ (2019a) and TCMB (2019)



In Fig. 1, the blue shaded line represents DAM prices of June 27, 2019. The green shaded area is the feed-in tariff calculated by the feed-in prices of the Law No. 5346 and daily exchange rate published by Turkey's Central Bank for 7.3 US dollar cents/kWh base feed-in tariff at the same date. As the DAM prices are paid in advance, the amount of money in the green shaded area is paid monthly to guarantee that RESUM power plant receives feed-in prices for generated energy. If DAM price exceeds the feed-in price, RESUM power plant pays the difference back to the market operator, EPIAS. On the other hand, if these power plants cannot balance their generation, they are charged to imbalance costs. When a power plant sells some amount of energy to DAM, and its generation is different from the energy sold in the market, it causes imbalances. Imbalances due to these differences are charged at the end of the month. This means that the support mechanism guarantees feed-in tariffs for generated energy, but total revenues are not guaranteed. Having the same responsibilities with other market players in the electricity market, the total revenue of a RESUM power plant depends on how effectively it manages the imbalance.

As mentioned earlier, RESUM power plants are paid feed-in prices determined by the Law No. 5346 for the electricity injected to the grid. Total feed-in payments are collected from suppliers based on their market shares. Therefore, the margin between spot market prices and feed-in prices becomes additional cost for consumers. The continuing increase in the US dollar exchange rate against TL increases this margin and the burden on consumers.

Even though the dispatch priority for renewable based power plants in RESUM is not defined clearly, the operation of the market ensures it. Because of increasing renewable generation, prices in spot markets are decreasing. Thus, this causes missing money problem in the electricity market. Technically speaking, missing money points to the situation in the spot electricity market where prices are not sufficiently high and therefore the capital of investment cannot be recovered (Hogan, 2017). Hogan (2017) reports that competitive wholesale

electricity market is known to suffer from a missing money problem, meaning that prices in the electricity market do not fully reflect the value of investment which are required for reliable electricity supply. This threatens the security of electricity supply for the long-term in the country.

On the other hand, renewable energy sources cause price volatilities in the short term and declines in spot market prices in the long term. In addition, renewable energy sources depend on natural conditions, causing short term price volatilities. Another challenge stemming from renewable energy is that the rapid development of renewable power plants makes the operation of the electricity network harder and increases the need for operation reserves because of intermittent generation.

4. DEVELOPMENTS IN RESUM

The share of renewable power plants in total installed capacity increased after 2005 when the Law No. 5346 came into force. The distribution of Turkey's primary sources of power and their installed capacities are shown in Fig. 2 and the development in the installed capacity of renewable sources is given in Fig. 3.

Fig. 2. The distribution of Turkey's installed capacity by source, data from TEİAŞ (2018a), TEİAŞ (2018b) and EPDK (2018b)

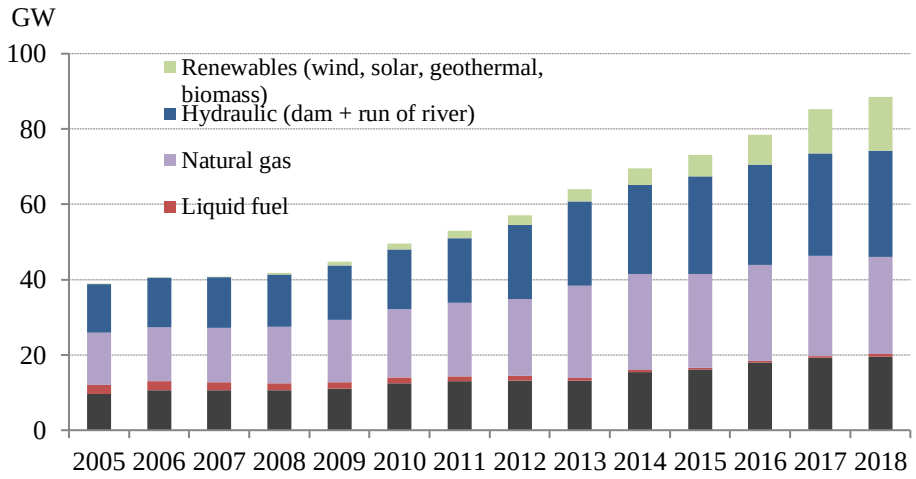
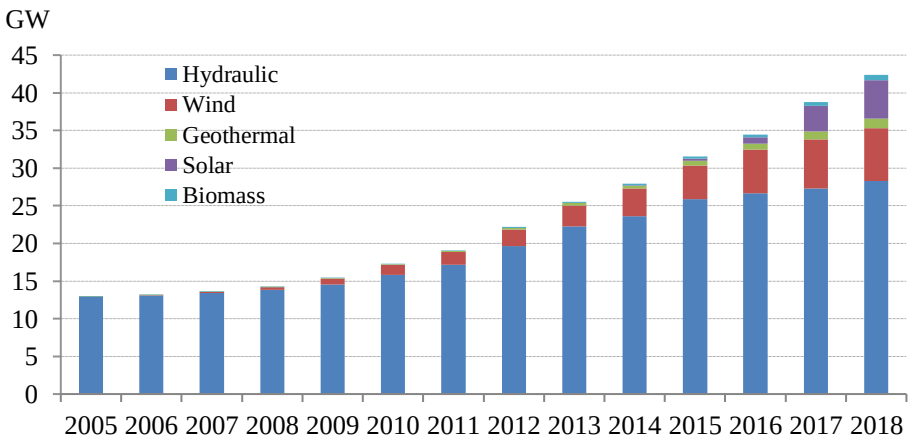


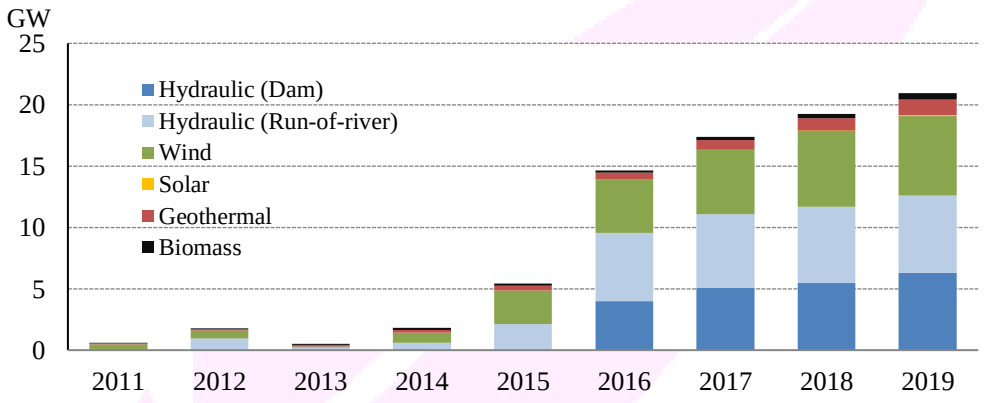
Fig. 3. The development of renewable based installed capacity, data from EPDK (2018b) and TEİAŞ (2019b)



Both Fig. 2 and Fig. 3 clearly show the trend of rapid increase in the capacity of renewable power plants in the last 10 years. In 2011, RESUM's total installed capacity including hydraulics was 19.084 MW. The share of this increase primarily belongs to hydraulic and wind power plants. On the other hand, there has been a rapid increase in solar power plants since 2016. As the end of 2018, solar installed capacity reached approximately 5.100 MW, of which 5.017 MW consists of distributed generation with installed capacity up to 1 MW.

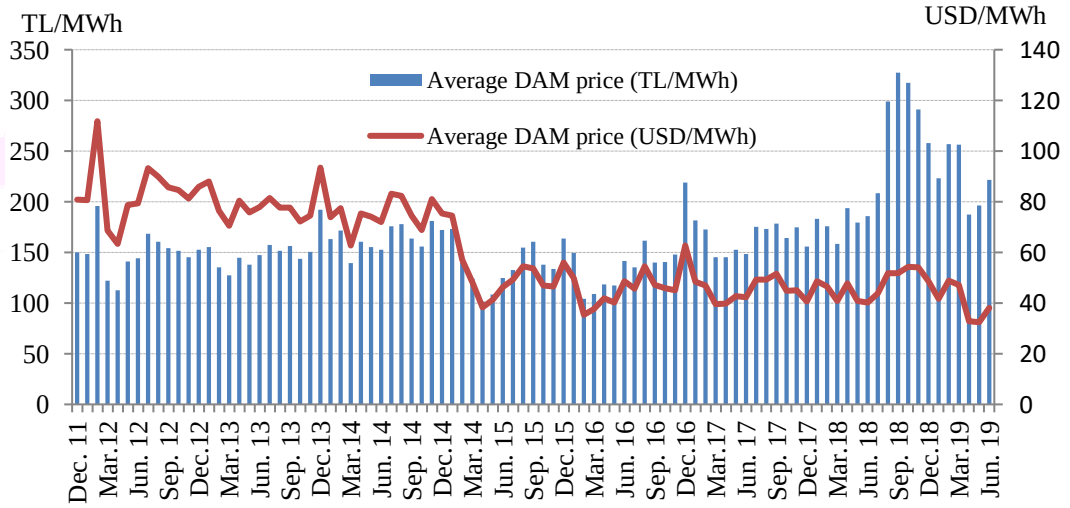
As mentioned above, RESUM is a voluntary mechanism. However, when the development of RESUM portfolio is analysed over the years, it is seen that companies demand less participation in RESUM between 2011 and 2014. On the other hand, by 2015, the installed capacity of the RESUM portfolio increased 3 times the previous year and reached 5.423 MW. In 2016, RESUM portfolio experienced the largest increase with a threefold increase compared to the previous year, and all generators benefited from RESUM in 2019 (see Fig. 4).

Fig. 4. The total installed capacity participating in RESUM, data from EPDK (2019d)



The increase in RESUM's portfolio is, of course, due to the introduction of new renewable installed capacity. However, the most important share in this increase belongs to increases in the US dollar exchange rate against TL and decreases in market prices which remain below feed-in tariffs. Monthly averages of MCPs formed in DAM in terms of TL and US dollars are shown in Fig. 5.

Fig. 5. Average DAM prices in TL and US dollars, data from EPİAŞ (2019a)



Prices, which remained above 70 US dollar/MWh until the last quarter of 2014, have fallen below feed-in tariffs since 2015. In this case, RESUM is no longer a voluntary mechanism for investors to choose to participate in, but it becomes almost mandatory to enter RESUM because market conditions enforce the participation of generators. Therefore, it can be said that all power plants that have the right to benefit since 2016 are included in RESUM.

One of the most important developments in the RESUM portfolio in 2016 is the addition of the hydraulic power plant with dams and, of totally installed capacity of more than 4.300 MW to RESUM. Withdrawing this amount of reserve from the real-time balancing mechanism has brought the threat that the problem will have a different dimension in the market and become a system security problem beyond a cost problem. However, as a result of the amendments made in April 2016, this problem was solved by removing exemptions regarding the obligations of RESUM participants to manage their own power plants and provide real-time balancing services.

5. THE PHASES OF RESUM AND SYSTEMATIC RISK FACTORS

The Law No. 5346 entered into force in 2005. In the electricity wholesale market, day ahead planning started in 2009 and DAM started operations in 2011. Along with these developments, RESUM was established by the amendments in the Law No. 5346 in 2011. The Grand National Assembly of Turkey adopted the Law No. 6094 on 29 December 2010, which envisaged, among other items, changes to the Law No. 5346. The Law No. 6094 was published in the Official Gazette of Turkey and became effective on January 8, 2011. However, the amendments to the secondary legislation envisaged by that amendment was only completed in the last half of 2011 and, thus, it was only possible to begin actual implementation of RESUM in December 2011. In April 2016, the mechanism was revised so that RESUM portfolio was integrated directly to the market. On the other hand, feed-in price is converted to TL from US dollars in January 2021 by the Presidential Decree No. 3453 (Resmi Gazete, 2021). In this regard, the developments in the promotion of electrical energy from renewable energy in Turkey can be classified into four phases. The key features of each phase are given in Table 1.

5.1. Phase I (Pre-Feed-in Tariff Period)

The pre-feed-in tariff period began in May 2005 when the Law No. 5346 came into force for the first time in Turkey. In fact, this period can be called pre-RESUM period because the support mechanism is not implemented at all. In the first version of the Law No. 5346, suppliers are obliged to purchase energy from renewable energy power plants in proportion to their market shares. The price of energy purchased through bilateral agreements is determined by EMRA as the annual average of electricity wholesale prices calculated all over Turkey and the quantity is limited to not being less than 8% of the total energy they sell to consumers (E-Mevzuat, 2019; EPDK, 2019e). With the amendments made in 2007, it was determined that the price in bilateral agreements with renewable energy power facilities would be TL equivalent of at least 5 Euro cent/kWh and TL equivalent of maximum 5.5 Euro cent/kWh (E-Mevzuat, 2019; EPDK, 2019e).

Table 1. Principal characteristics of support mechanism phases

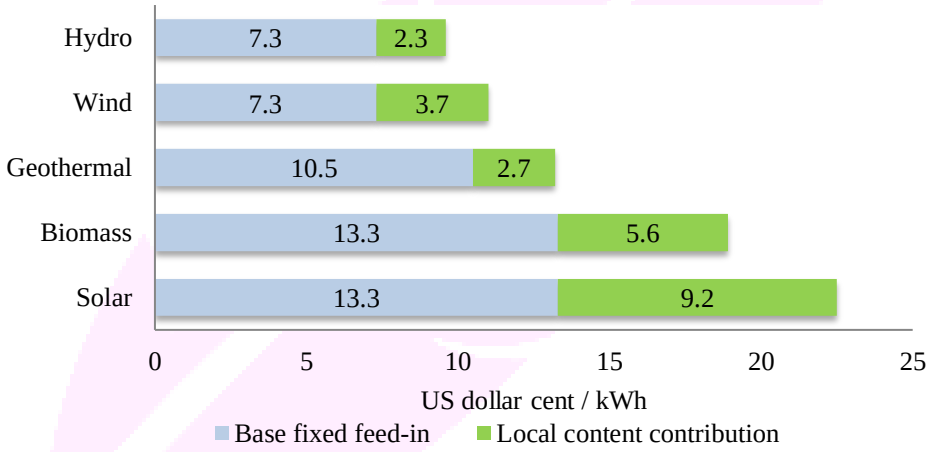
	Phase I (Pre-feed-in tariff period)	Phase II (Feed-in tariff period I)	Phase III (Feed-in tariff period II)	Phase IV (Feed-in tariff period III)
Implementation period	May 2005 – January 2011	January 2011 – April 2016	April 2016 – January 2021	January 2021 –
Legislation that specifies the beginning and end of the period	(The Law No. 5346 – The Law No. 6094)	(The Law No. 6094 – Amendment in the by-law on RESUM in April 2016 and Amendment in BS Regulation in May 2016)	(Amendment in the by-law on RESUM in April 2016 and Amendment in BS Regulation in May 2016 – The Presidential Decree No. 3453)	(The Presidential Decree No. 3453 – …)
Support mechanism	Annual average of Turkish electricity wholesale prices (Turkish Lira kuruş / kWh) Support price can not be lower than the TL kuruş / kWh equivalent of 5 Euro cents or higher than the TL kuruş / kWh equivalent of 5.5 Euro cents / kWh.	Feed-in price (US dollar cents / kWh)	Feed-in price (US dollar cents / kWh)	Feed-in price (Turkish Lira kuruş / kWh) The TL equivalent of a certain price in US dollars, which is set in Presidential Decree No.3453 on the basis of renewable energy, is specified as the upper limit of escalation.
Support duration	7 years	10 years	10 years	10 years
Balancing responsibility	No	No	Yes	Yes

5.2. Phase II (Feed-in Tariff Period I)

In line with the developments in the wholesale electricity market in 2011, significant changes were made in the Law No. 5346 to support energy generation from renewable sources with feed-in tariffs and ensure that energy was supplied within the market mechanism. This was a new support mechanism. Participation in this mechanism which is called RESUM was a voluntary mechanism for renewable energy power plants and enabled its participants to sell the energy they generated within the market conditions or participated in the support mechanism to fix their revenue.

Feed-in tariffs consisted of two parts. The first part consisted of the unit prices for electrical energy determined according to the source and technology type and the second part was added to the first part for the usage of locally manufactured content (see Fig. 6). Fig. 6 shows the basic feed-in tariff for each source type and the maximum domestic product contribution a RESUM participant can receive. For example, while feed-in tariff for a wind farm is 7.3 US dollar cents/kWh, it can generate an additional contribution of 3.7 US dollar cents/kWh if all components specified in the Law No. 5346 are domestic production (E-Mevzuat, 2019).

Fig. 6. Feed-in tariffs for electricity and local content usage, data from E-Mevzuat (2019)



In the second phase, RESUM power plants were gathered under the RESUM portfolio managed by TEIAS as a virtual company and market participant. During this period, RESUM participants were not directly market participants. TEIAS was responsible for estimating the energy generated under RESUM and supplying it to DAM. Since RESUM power plants were removed from the portfolios of the relevant participants and included in the RESUM portfolio, legal entities without a power plant that did not benefit from RESUM did not qualify as market participants. For this reason, they were not the counterparts of settlement accounts and imbalances. During this period, the settlement of the RESUM portfolio was made on behalf of TEIAS and the imbalance costs were transferred to TEIAS. In this case, the payment made to a RESUM participant in one month was determined according to formula (1).

$$R_p = \sum_s Q_{s,p} \; x \; P_p \; x \; E_s \qquad (1)$$

In the formula (1), each parameter has the following meanings.

R_p: The amount to be paid to the generation facility p of RESUM participant in one month (*TL*)

$Q_{s,p}$: The amount of energy generated by the generation facility p and injected to the grid during the settlement period s (*MWh*)

P_p: Unit price to be applied for the generation facility p (*TL/MWh*)

E_s: The daily exchange rate for the settlement period s (*TL/USD*)

s: All settlement periods in a month

As shown in the formula (1), the revenue of a RESUM power plant depends only on the amount of energy it generates. The feed-in price is a price determined in the Law No. 5346. The exchange rate is the daily exchange rate published by Turkey's Central Bank and can be regarded as an external value for the electricity market. During this period, a RESUM participant did not need to observe market conditions or try to make less imbalance to increase its revenue. The only remaining variable was the generation amount. Since the generation amount depended on natural conditions, all the participants had to keep the power plant in working condition.

The general framework outlined in the Law No. 5346 states that payments to RESUM participant power plants will be reflected to the suppliers in proportion to their market shares. In other words, consumers bear the costs of supporting renewable energy. Total RESUM payments to suppliers are calculated according to the formula (2).

$$TR = \sum_{P} R_p = \sum_{P} \sum_{S} Q_{s,p} \; x \; TF_p \; x \; E_s \qquad (2)$$

In the formula (2), TR refers to the total monthly payments to RESUM participants (*TL*) and p refers to all power plants participating in RESUM. The energy supplied to DAM by TEIAS is purchased over MCP and generates an income on behalf of RESUM portfolio. In this case, RESUM's portfolio income is calculated as follows.

$$TR_p = \sum_{P} \sum_{S} Q_{s,p} \; x \; MCP_s \qquad (3)$$

In the formula (3), TR_p refers to monthly earnings of RESUM portfolio (*TL*) and MCP_s refers to market clearing price for the settlement period s (*TL/MWh*). The earnings, calculated by the formula (3), are distributed to all suppliers active in the market by their market shares. In this case, the difference in the amounts calculated in the formulas (2) and (3) represents the cost incurred by consumers:

$$TR_c = TR - TR_p = \sum_{P} \sum_{S} Q_{s,p} \; x \; (P_p \; x \; E_s - \; MCP_s) \qquad (4)$$

In the formula (4), TRc refers to the total cost of RESUM reflected to consumers in one month (*TL*). As seen in the formula (4), the total cost of RESUM reflected to consumers varies depending on the generation amount under RESUM and the difference between feed-in tariffs

and market prices. The most important variable affecting feed-in tariffs is the US dollar exchange rate against TL. In this respect, the main reason why RESUM is creating extra costs for consumers is that the market prices are lower than feed-in prices and the increasing gap between the payments made and the income obtained. The reasons for this are the increase in the US dollar exchange rate against TL and the decrease in prices in the wholesale electricity markets.

5.3. Phase III (Feed-in Tariff Period II)

The current period of implementation in Turkey is phase III and still in operation. In April 2016, with the amendments made by EMRA in the RESUM regulation, the RESUM portfolio managed by TEIAS was abolished (EPDK, 2019b). Consequently, all RESUM participants have become market participants and RESUM power plants have remained in the portfolio of market participants. RESUM participants, like other market participants, became responsible for managing their own portfolios. In this context, it is the responsibility of the market participant to make generation forecasts, schedule generation, supply the energy to the market, and manage the imbalances of RESUM power plants. In this period, feed-in tariffs remain in force.

While the energy generated within the scope of RESUM is previously introduced to the market by TEIAS under the RESUM portfolio, after the revision in April 2016, the supply of the said energy to the market is under the responsibility of the related portfolio owner. Market participants can supply their energy to markets in many ways. They can sell their energy in bilateral agreements or spot markets or supply them to eligible consumers with whom they have signed contracts. Since RESUM participants are not different from other market participants, they can generate income by supplying the energy they generate to the market in any way. As mentioned above, since the reference price in the electricity wholesale market is MCP formed in the DAM, it is assumed that the participant earns income from the markets through MCP. In this case, the payment to be made to the RESUM participant at the end of the month becomes as follows.

$$TR_p = \sum_s Q_{s,p}\ x\ (P_p - MCP_s\ x\ j)\ x\ E_s \qquad (5)$$

In the formula (5), each parameter has the following meanings.

TR_p: The payment to be made to the RESUM participant power plant p in one month (*TL*)

$Q_{s,p}$: The amount of energy generated by the power plant p and injected to the grid during the settlement period s (*MWh*)

P_p: Unit price to be applied for the power plant p (*TL/MWh*)

MCP_s: Market clearing price for the settlement period s (*TL/MWh*)

j: The tolerance coefficient

E_s: The daily exchange rate for the settlement period s (*TL/USD*)

s: All settlement periods in a month

In order to find the total income obtained by a RESUM power plant, the payment calculated by the formula (5) and the income obtained from MCP are summed and the following equation is obtained.

$$TTR_p = TR_p + \sum_s Q_{s,p}\, x\, (MCP_s) = \sum_s Q_{s,p}\, x\, P_p\, x\, E_s + \sum_s Q_{s,p}\, x\, MCP_s\, x(1-j) \quad (6)$$

In the formula (6), TTRp refers to the monthly revenue generated by the RESUM participant p power plant (*TL*). Unlike the formula (1), it is seen that MCP formed in DAM is among the variables affecting the income of the power plant. Note that the first part of formula (6) is the same as formula (1). In addition, RESUM participants are given the opportunity to generate additional income within a certain tolerance.

As a natural result of the fact that the power plants continue to be included in the portfolios of market participants, one of the important changes in Phase III was the fact that the market participants became responsible for the imbalances of RESUM power plants. Since there are no exemptions in both the Law No. 5346 and the RESUM Regulation, the market participants bear the imbalance cost. In other words, the imbalance cost previously assumed by TEIAS has remained the responsibility of the market participants in Phase III. On the other hand, the exemptions of RESUM power plants with the necessary features regarding real-time balancing have been removed. The tolerance coefficient in the formulas (5) and (6) also enables market participants to manage their portfolios effectively and generate extra revenue. This coefficient was initially determined as 0.98 for all source types (TEİAŞ, 2019a; EPDK, 2019d), and then decomposed according to source types (see Table 2).

Table 2. Tolerance coefficients for different sources, data from EPDK (2017) and EPDK (2019e)

	May 1, 2016 – Dec. 31, 2017	Jan. 1, 2019 - present
Hydraulic (run of river)	0.980	0.980
Hydraulic (with dam)	0.980	1.000
Wind	0.980	0.970
Solar	0.980	0.980
Geothermal	0.980	0.995
Biomass	0.980	0.990

For example, a tolerance coefficient of 0.98 provides the RESUM participant with an additional revenue equal to 2% of MCP. Market participants who manage their portfolio well and reduce imbalance costs could earn income above feed-in tariffs, while those who manage their portfolio poorly have the possibility that the second part of the formula (6) would not be enough to cover imbalance charges. Furthermore, since the reference price is MCP in all these calculations, it is possible for the market participant to increase its income above feed-in tariffs if it sells its energy at a better price, for example through bilateral agreements. It is also

important to note that, for example, a 2% tolerance corresponding to a coefficient of 0.98 can physically compensate for larger imbalances of 10-15%.

On the other hand, the tolerance provided by the tolerance coefficient in above calculations is a financial one, not a physical one. There is currently no exception, exemption or imbalance tolerance for RESUM participants physically. If a physical imbalance tolerance is recognized, there is the possibility that RESUM participants may deliberately sell as much energy as the amount of tolerance in order to increase their income. Since the applied tolerance coefficient is a financial tolerance for settlement calculations, it aims to increase the income by minimizing imbalances of market participant.

In Phase II, while RESUM participants focused on generating energy and supplying it to the grid, with the changes made in Phase III, like other market participants, RESUM participants must accurately predict their generation and supply them to the market, manage their portfolios, and bear the costs of their imbalances. On the other hand, with the tolerance coefficient applied, RESUM participants have been dealing with market prices, albeit limited, and can increase their income by trading better prices in different markets. In addition, the power plants that are qualified as balancing units will continue to participate in the BPM and ancillary services, thus providing both the additional profit opportunities and the required reserves in the electricity system.

Since there is no change in the support mechanism drawn up by the Law No. 5346 in this period, no change has been made in the amount to be collected from suppliers and this amount is calculated as in formula (2). However, since RESUM portfolio is abolished in practice, the income of RESUM portfolio becomes as follows.

$$TR_m = \sum_P \sum_S Q_{s,p} \; x \; MCP_s \; x \; j \tag{7}$$

In the formula (7), TRm refers to RESUM income from the supply of energy generated from RESUM participant power plants to the market (*TL*) and P refers to all power plants participating in RESUM. The costs incurred by suppliers and consumers are calculated by subtracting the values obtained by the formulas (2) and (7) as follows.

$$TR_c = TR - TR_m = \sum_P \sum_S Q_{s,p} \; x \; (P_p \; x \; E_s - (MCP_s \; x \; j)) \tag{8}$$

Note that the different term between formulas (3) and (4) and formulas (7) and (8) is only the tolerance coefficient. As a result, the general principles of the support mechanism have been laid down by the Law No. 5346, but the supply and financial settlement of the energy generated by this mechanism is regulated by the secondary regulation on balancing and settlement issued by EMRA. In this respect, there is essentially no difference between inputs and outputs between Phase II and Phase III. The difference is related to the roles of market players and cash flows. The tolerance coefficient applied in Phase III also aims to manage the energy generated under the mechanism more effectively and efficiently, to make it partially sensitive to market conditions and to increase the level of integration to wholesale markets.

5.4. Phase IV (Feed-in Tariff Period III)

As mentioned earlier, this phase has not yet begun. The principles of this phase will be applied to power plants that will be in operation after June 30, 2021. As in the third phase, the functioning of the support system in this phase will continue within the principles of the third phase. The support price, the domestic contribution and the principles of escalation to be implemented during this period were determined by the Presidential Decree No. 3453 (Resmi Gazete, 2021). It should be noted that power plants which have not completed 10 years of the support mechanism which entered into service before 1 July 2021 will be entitled to benefit from the support mechanism in US dollars until the end of the 10-year term.

The support price to be applied in the fourth phase will be in TL instead of US dollars, unlike in the previous phase (Resmi Gazete, 2021). This implies the conversion of the support price from US dollars to TL. Feed-in prices in TL will be revised on a quarterly basis. Energy support price and domestic contribution will be revised quarterly within the scope of the new support regime, taking into account adjustments in US dollars, Euro, Producer Price Index (*PPI*), and Consumer Price Index (*CPI*). In the update formula, the shares of the US dollar and Euro are 26 percent, while the shares of PPI and CPI are 24 percent. An escalation upper limit has been introduced for the value determined as a result of the revision. According to the most recent support regulation, the domestic contribution is set at 8 TL kuruş/kWh for all sources and technologies.

Support rates in kWh and the related upper limits are determined as follows,

- 32 TL kuruş for wind, solar, landfill gas, and sources derived from by-products from the processing of waste tires, with an escalation upper limit of TL kuruş equivalent of 5.10 US dollar cents/kWh
- 40 TL kuruş for hydraulic, with an escalation upper limit of TL kuruş equivalent of 6.40 US dollar cents/kWh
- 50 TL kuruş for thermal disposal, with an escalation upper limit of TL kuruş equivalent of 8.00 US dollar cents/kWh
- 54 TL kuruş for geothermal and biomethanization, with an escalation upper limit of TL kuruş equivalent of 8.60 US dollar cents/kWh

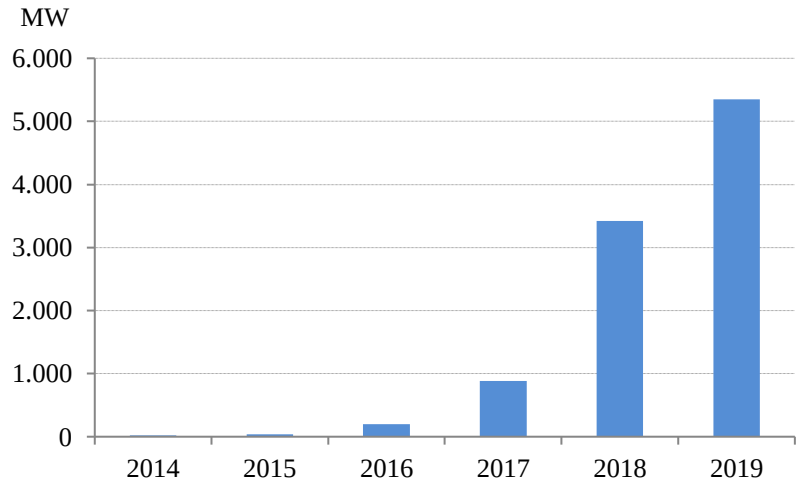
5.5. Unlicensed Electricity Generation

As explained in section 2, any interested party is required first to obtain the relevant license from EMRA to operate in the electricity market. However, the Law No. 6446 provides exceptions for certain power plants. The most important of these is the generation facilities based on renewable energy with an installed capacity up to 5 MW. In addition, cogeneration facilities with certain efficiency can operate without license. Unlicensed power plants are the ones established by consumers to meet their own consumption. According to the Law No. 6446 published in the Official Gazette in 2013, renewable based power plants with an installed capacity up to 1 MW can generate electricity without a license (E-Mevzuat, 2013). In 2019, the limit for installed capacity was increased to 5 MW, but the installed capacity of the power plant is limited to the connection capacity of the associated consumption unit (E-Mevzuat, 2013).

The main purpose of unlicensed generation is that consumers meet their own consumption. For power plants that generate more than they consume and supply surplus energy to the grid, different rules are applied depending on the type of power plant. In addition, the feed-in tariffs given in Table 1 are applied to unlicensed renewable power plants for their surplus generation to the grid. However, as underlined before, feed-in tariffs for unlicensed power plants established after 2018 are determined to be equal to retail sales tariffs approved by EMRA board.

There has been a rapid increase in unlicensed power plants especially since 2016. The change in the installed capacity of unlicensed power facilities by years is given in Fig. 7. As the end of June 2019, unlicensed facilities reached 5.811 MW and of this capacity 5.369 MW belongs to solar power plants (EPDK, 2018b; TEİAŞ, 2018c; EPDK, 2019f; TEİAŞ, 2019b) (see Fig. 7). The most important reasons for this increase are that feed-in tariffs have become profitable as a result of the decrease in plant installation costs and the increase in the US dollar exchange rate against TL since 2015.

Fig. 7. Developments in installed capacity of unlicensed power plants, data from EPDK (2019f)



Incumbent suppliers are charged by the Law No. 5346 to purchase and supply the energy generated from unlicensed generation facilities to the market. Incumbent suppliers are operating in 21 distribution regions in Turkey and are responsible for retail electricity sales through regulated tariffs for consumers by EMRA. These companies are also natural members of the support mechanism. Since unlicensed generators cannot become market participants, incumbent suppliers in charge assume a role like generation companies that generate electricity from renewable energy sources in terms of wholesale markets.

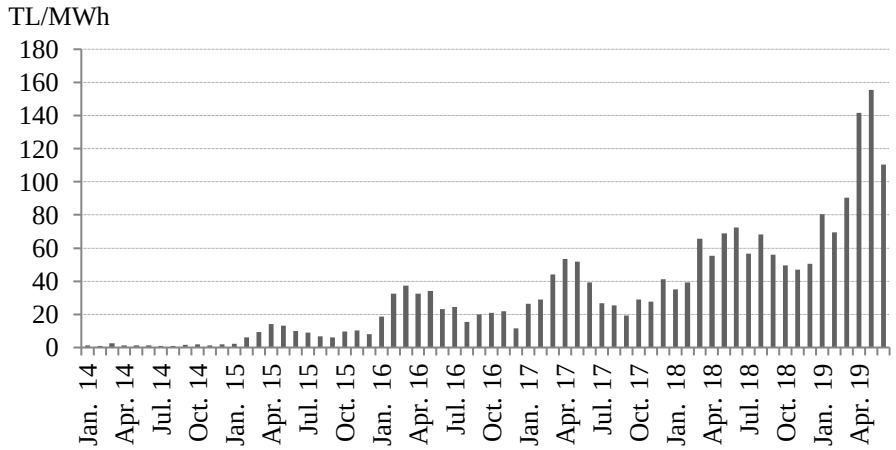
It is the duty of incumbent suppliers to manage the unlicensed generation portfolio in their respective regions, to supply the generated energy to the markets, and to determine the surplus energy by measuring the generation and consumption values. In terms of unlicensed renewable power plants, the situation is like the model in which the RESUM portfolio is managed by TEIAS, as in Phase II. The energy generated in the unlicensed generation portfolio is also included in the calculations made in the above formulas. Unlike other participants, incumbent suppliers pass to unlicensed generators the support values received from the market operator.

6. DISCUSSION AND POLICY RECOMMENDATIONS

The cost of feed-in tariffs under RESUM continues to increase since 2015 (EPİAŞ, 2019b). The reason is that feed-in tariffs are defined in US dollars and the US dollar exchange rate against TL continues to increase in Turkey. As the margin between feed-in prices and market prices increases, the cost that consumers must undertake increases. The unit cost charged to consumers exceeded 70 TL/MWh as of June 2018 (EPİAŞ, 2019b). By taking into consideration that the average MCP is about 185 TL/MWh at this period, approximately 1/3 of the energy cost except for taxes and grid costs consists of RESUM cost (EPİAŞ, 2019b). For May 2019, unit cost reached 155 TL/MWh while average MCP is 196 TL/MWh (EPİAŞ, 2019b). This is mainly due to the increase in the US dollar exchange rate against TL.

The importance of the cost of RESUM reflected to consumers emerges precisely when the difference between wholesale electricity prices and feed-in tariffs increases. As seen in formula (4) and formula (8), the parameters that affect the cost reflected to consumers within the scope of RESUM are generation quantity, MCP, and the US dollar exchange rate against TL. On the other hand, feed-in tariffs and tolerance coefficients are predetermined and fixed. While wholesale market prices are close to or higher than feed-in tariffs, payments to RESUM power plants are reflected to consumers as a limited extra cost. It is even possible that the formulas (4) and (8) give negative results during the periods when the market prices are above feed-in tariffs (see Fig.1). However, when the difference between market prices and feed-in tariffs increases due to increase in the US dollar exchange rate against TL, RESUM becomes costly for consumers (see Fig. 8).

Fig. 8. Cost of RESUM (TL/MWh), data from EPİAŞ (2019b)



Due to the mechanism envisaged by the Law No. 5346 and RESUM during Phase II, Turkey has achieved significant success in promoting renewable energy. Despite this success, feed-in tariffs have caused huge costs. Although the revision of the secondary legislation aims to use renewable energy more efficiently in Phase III, the cost figure remains a major problem since the feed-in tariff is defined by the Law No. 5346. The unpredictability of costs poses a significant risk, especially for suppliers and consumers. This is mainly due to the uncertainty in the US dollar exchange rate against TL in addition to macroeconomic indicators such as economic growth, inflation, and interest rates. The systematic risks of RESUM on stakeholders can be classified and explained in Table 3.

Table 3. Systematic risks faced by stakeholders

Stakeholders	Explanation and comments
The system operator	Even though the problems that emerged in Phase II were solved in Phase III, intermittent generation poses risks to the system operator and increases the need for reserve capacity.
Renewable electricity generators	The most important risk factors for renewable energy generators are political and regulatory uncertainties. A regulatory risk can be generated by fast and regular modification of regulations.
Conventional electricity generators	Increasing renewable energy generation leads to the fact that conventional power plants are becoming less dispatched and that lower prices in the wholesale electricity market lead to the problem of missing money. This causes long-term investment risk in the country.
Suppliers	High US dollar exchange rate against TL and the variability of renewable energy generation over the year create price risks on suppliers. As it is not possible to estimate the amount to be calculated from RESUM on the basis of the market share of suppliers, suppliers are exposed to price risk in electricity sales to eligible customers under market conditions. Since the cost of RESUM is included in the price charged by the supplier to the eligible consumer, an amount of RESUM greater than the cost estimated by the supplier will cause a loss for the supplier. For example, the sum of RESUM unit cost and spot market prices exceeds retail prices for some months (EPDK, 2019g). Moreover, after June 30, 2021, the Euro exchange rates against TL, PPI and CPI are also considered to be new systematic risk factors.
Consumers	The full cost of RESUM is somehow reflected to consumers. The risk to consumers stems mainly from the uncertainty of the US dollar exchange rate against TL. As RESUM costs increase, the relation between spot wholesale market prices and retail prices disappears. On the other hand, it is presumed that, after 30 June 2021, the aforementioned systematic risk factors for suppliers will also extend to customers.

Referring to Table 3, intermittent generation poses risks to the system operator. Increases in renewable based electricity generation result in less dispatch of conventional power plants and this creates the missing money problem. A major systematic risk factor for consumers is uncertainty about the US dollar exchange against TL. On the other hand, the high exchange rate of the US dollar against TL and the volatility of renewable energy generation are creating price risks for suppliers. Our comments are given below regarding the implementation of RESUM in Turkey.

- Turkey has achieved significant success in increasing the installed capacity of renewable based power plants with RESUM.

- In line with the developments in the organized wholesale electricity markets, RESUM is a successful application for the integration of renewable energy into the markets. Especially after the amendment in the by-law on RESUM (*Regulation on Certification and Support of Renewable Energy Resources*) in April 2016, this integration reached higher levels with Phase III.

- Because of the reasons such as the rapid growth of supply than demand in Turkey, the rising in the US dollar exchange rate against TL in recent years, the use of the dominant power in the hands of the public in the markets to suppress prices, the difference between feed-in tariffs and wholesale electricity market prices is widening and as a result, RESUM brings extra cost to consumers.

- If uncertainties in macroeconomic developments persist, uncertainties in RESUM costs will continue. This problem does not arise from electricity markets, but from general economic conditions.

- In the period in which RESUM came into force, it is observed that feed-in tariffs are determined close to market prices. In a recent study, it is seen that investment costs of renewable power plants have been in a decreasing trend over the past years (IEA, 2018). As a matter of fact, the wind capacity auctions organized by TEIAS and the Ministry of Energy and Natural Resources confirm this. According to the results of the auctions conducted by TEIAS and the Ministry of Energy and Natural Resources, Turkey experienced a relatively lower feed-in tariffs of 6.99 US dollar cents/kWh for solar (NTV, 2019) and even -2.87 US dollar cents/kWh for wind (TUREB, 2019). Negative feed-in tariff for wind projects means that the project is feasible enough to make money in the free market. Thus, the project owner accepts to pay a certain contribution to the system operator without joining RESUM and instead selling the output in the free market.

- If feed-in tariffs continue to be implemented after June 30, 2021, support prices should be dynamically determined and escalated in line with market conditions.

- In view of the tariffs imposed by the new support regulation, the Presidential Decree No. 3453, it is considered that the Euro exchange rate against TL, PPI and CPI may affect stakeholders as new systematic risk factors in addition to the US dollar exchange rate against TL.

- The support mechanism in Turkey has led to an increase in power generation based on renewable energy. This increase leads to less dispatch of conventional power

plants, lower market prices, and the problem of missing money. This situation may create a long-term investment risk in the country. From this point of view, the potential consequences of the new regulation put into force by the Presidential Decree No. 3453 on the electricity market are considered to be a separate study.

Instead of current feed-in tariff application, it is suggested that feed-in premium or hybrid mechanisms such as auctioning feed-in prices can be implemented after June 30, 2021. This ensures that the support mechanism has a market-based structure. Moreover, the financial burden on consumers can be reduced relatively. In addition, the risk to be exposed to suppliers is lowered to a manageable level to enable them to trade in the electricity market. The results of the auctions organized by TEIAS and the Ministry of Energy and Natural Resources support our proposal. Another alternative would be to design incentive schemes based on domestic currency, but this may result in another investment risk for renewable based generators on unstable economic conditions. Therefore, it would be appropriate to continue a support mechanism in US dollars in the electricity market in the foreseeable future. If TL is set as a currency instead of US dollars, an acceptable escalation formula would need to be developed for the success of the support mechanism. However, in order to continue successfully supporting the generation of energy from renewable sources, it is beneficial for related parties to be aware of the risks they are exposed to. In addition, whatever policy is implemented as a support mechanism, the existence of a predictable and competitive market is required for the effective functioning of the support mechanism and risk management.

7. CONCLUSIONS

In Turkey, in May 2005, the Law No. 5346 was enacted to support the electricity generated from renewable energy sources. In the first version of the Law No. 5346, suppliers are required to purchase renewable based electricity in proportion to their market shares at a price of the average wholesale electricity price calculated all over Turkey and determined by EMRA (E-Mevzuat, 2019; EPDK, 2019e). No single license holder has applied to benefit from the support mechanism until December 2011 because of relatively higher market prices (EPDK, 2019d). By an amendment in the Law No. 5346 in 2011, a new support mechanism was introduced and the electrical energy from renewable energy sources has been supported by feed-in tariff since December 2011 (E-Mevzuat, 2019; EPDK, 2019e). Therefore, the actual implementation of RESUM began in December 2011 because significant developments achieved in organized electricity markets. Due to RESUM, the installed capacity based on renewable energy increased by 2.6 times and reached 49 GW (TEİAŞ, 2021; TEİAŞ, 2018b). The support mechanism guarantees generators to obtain fixed revenue for the electrical energy injected to the grid. In the first 5 years of RESUM implementation, many renewable based electricity generators selected to sell their output in the free market due to relatively higher market prices. However, this had changed since 2015 because of increasing the US dollar exchange rate against TL and relatively low market prices (EPDK, 2018b). Therefore, almost all eligible renewable based power plants have participated in RESUM since January 2016 (EPDK, 2019d). The unexpected increase in the RESUM portfolio and the rise in the exchange rate of the US dollar against TL have resulted in more risk growth for market participants and consumers.

In this paper, the support provided to electricity generation from renewable energy sources in Turkey and the associated systematic risks on stakeholders due to RESUM are examined. We have noted that the most significant risk is that the cost on suppliers and

consumers cannot be foreseen due to the volatility of the US dollar exchange rate against TL. Moreover, the Euro exchange rate against TL, PPI and CPI are likely to be crucial new systematic risk factors after June 30, 2021. On the other hand, increasing renewable energy generation leads to the fact that conventional power plants are becoming less dispatched and lower prices lead to the problem of missing money. This causes long-term investment risk in the country. Generation intermittency poses risks to the system operator and increases the need for reserve capacity. Moreover, the fact that regulations are changed rapidly creates a regulatory risk as well. In the country, the entire cost of support mechanism is charged to consumers. Since the Law No. 5346 regulates a feed-in tariff, it is recommended that feed-in premium or hybrid mechanisms such as auctioning feed-in prices can be a choice following the period starting July 1, 2021. It is assumed that the performance of the support method depends primarily on predictable and stable macroeconomic conditions, taking into account the systematic risk factors listed above.

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