OVERVIEW OF ENERGY MARKETING DEVELOPMENTS IN TURKEY

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Abstract- Since efficient use of electric energy makes a large contribution to the national economy, the restructuringof the electricity market in many countries around the world has undergone a vital change during the last decades. Supply-demand balance is the most important parameter in the electricity market and it needs to be managed. Creation of energy market, day-ahead market, real time market, demand response, demand side management etc. are examples to perform the supply-demand balance. In this paper, general information is given about the development of electricity market in the world and also liberalization of Turkey's electricity market is discussed. Finally,it will focus on recommendations for future workrelated to the development of the electricity market.

Keywords- Day-ahead Marketing, Energy Marketing,Imbalance Marketing, Intraday Marketing

I. INTRODUCTION

Energy consumption ofcountries have a close relationshipwith theireconomical, technological, social development[1]–[3]. From this aspect, electrical energy plays a very important role in human life.Since the energy demand gradually increases by developing technologies, managing the optimum level of available resourcesbecomes more important. In this context, solutions related to supplying the demand, reducing environmental impacts and optimizing costsshould be developed.

Liberalization of electricity market has beenobserved all around the world in the last 30 years. It began in 1980 in Chili and in 1989 in England [4].After then, electricitymarket competition have been introduced in Wales, Norway, Argentina, Australia, Spain,Peru, Bolivia and Colombia, Brazil and the Central American countries,respectively[5], [6].Liberalization of the electric power market in Europe started in the late 1990s and continues. In the electricity market reform process, the steps taken are as follows [7]:

- Privatization theservices related to government,
- A law related the electric reform entry into force,
- Generation, transmission and distribution are separated from the vertically integrated structure,
- The establishment of an independent regulator,
- The establishment ofcompetitive wholesale market,
- The realization of liberalization in the retail market

In this paper, general information is given relatedto the liberalization of Turkey's electricity market. The aim of this study is todemonstrate the reforms carried out in Turkey and determine the future market strategy.

The rest of the study is organized as follows: Section 2 presents monopoly, single buyer, wholesale and retail electricity market. Section 3discusses the developments of market structure. Section 4gives the information about the day-ahead, intraday and balancing market operation. Finally Section 5.

II. ELECTRICITY MARKET MODELING

Initially, electricity was delivered to end users based on the monopolies.Nowadays, there is a more transparent electricity market in order to improve service quality andprovide more options to end users.Generally electricity markets can be classified into fourmodels: monopoly, single buyer, wholesale and retail electricity market [8].In the process of liberalization in the electricity market, it has begun transition from monopolistic structure to competitive structure in countries. In addition, reasons of irregular competition market model are listed as follows:

- Deficit of producers
- Long power plant installations
- Higher capital requirements
- Transmission charges and transmission losses

In monopoly electricity market, vertical integrated structure manages the production, transmission and distribution (Fig. 1). There is no competition between producers in this market model.

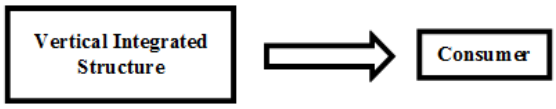


Fig.1. Monopoly electricity market[9]

Single buyer market allow competition between producers (Fig. 2). Although transition to single buyer market model is easy, single buyer is not subject to market forces[8], [9].

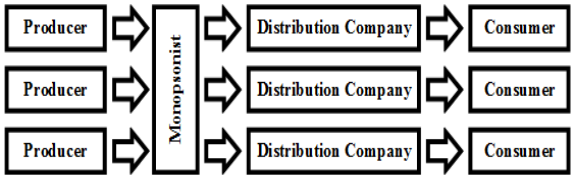


Fig.2. Single buyerelectricity market[9]

In the wholesale market,wholesale activities become competitive. However, distribution companies act as a monopoly to the end users (Fig. 3.). Generated electric by producers is sold in the wholesale market.Distribution companies and large consumers compete in this market model[8].

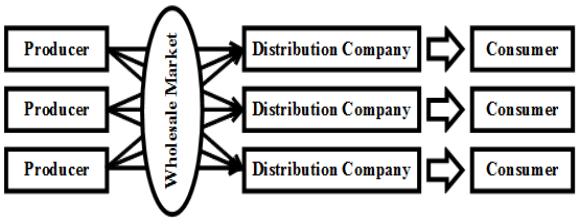


Fig.3. Wholesale electricity market[9]

Consumer can select own producer in the retail market model. In this market model, production, wholesale and retail activities are conducted in a competitive environment called as perfect competition(Fig. 4.).

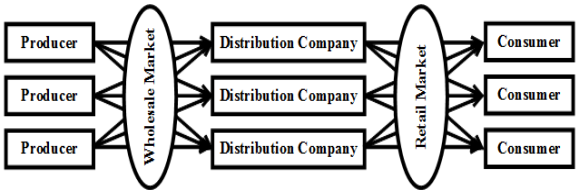


Fig.4. Wholesale and retail electricity market[9]

Comparison between monopoly and perfect competition is presented in Fig. 5.[10].

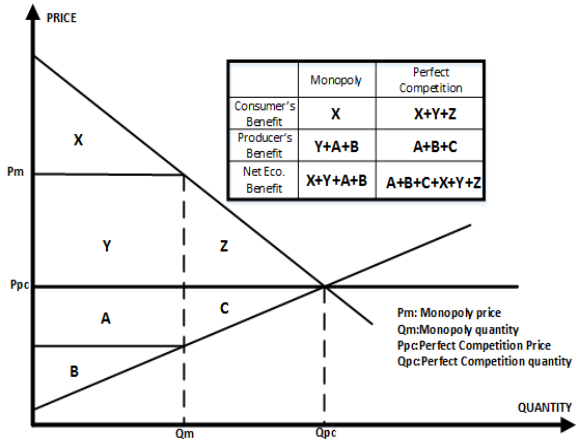


Fig.5. Comparison of monopoly and perfect competition market structure

III. LIBERALIZATION OF THE TURKEY ELECTRICITY MARKET

In order to construct theelectricity market, Turkish Electricity Administration (TEK) was established in 1970. TEK represents the vertically integrated structure in this market. The first changes occurred in 1982, by Law No. 2705, the private sector is given the opportunity to invest in power plants.With these changes in the electricity market in Turkey it was began the transition from the vertically integrated structureto competitive structure.The liberalization process in Turkish electricity market was started in 1984 by Law No. 3096. In 1993, Turkish Electricity Generation and Transmission Corporation (TEAS) and Turkish Electricity Distribution Corporation (TEDAS) were established instead of TEK. In 1994-1999, arrangements are made for the model that include build-operate (BO), build-operate-transfer (BOT), or transfer of operational rights (TOOR) contracts with the government. Then, TEAS is divided into three dependent parts which are Turkey Electricity Transmission Company (TEIAS), Turkish Electricity Generation Corporation (EUAS), and Turkish Electricity Trade and Contracting Corporation (TETAS) in 2001.The Electricity Market Law (EML), also enacted in 2001. This law containing the following main provisions of the planned reforms[11]:

- The Energy Market Regulatory Authority (EMRA) was established for the restructuring the electricity market.
- For market participants,a licensing framework.
- Bilateral contracts between market participants in market operation.
- In order to ensure freedom eligible consumer to choose their supplier, the eligible consumer conceptis accepted.

According to the Turkish High Planning Council adopted Electricity Sector Strategy Paper, ‘‘The liberal market structure to be implemented in Turkey is based on bilateral contracting between buyers and sellers, complemented by a balancing & settlement mechanism. To achieve the objectives and principles of this strategy it is essential that the balancing &settlement regime acts as a market where uncontract generation can be bought and sold and the application enhances security of supply by facilitating participation of independent and small generators ... Balancing and settlement mechanism will involve the target for establishment of a spot market and will include signals to attract new investments”[11]. Balancing and Settlement System (BSS) is the one of the primary component in this strategy paper. BSS allows the real time balancing the supply and demand according to acceptance of bids and offer. Then,a new system was started on an hourly basis called day-ahead planning in 2009. Day-ahead planning makes system operator work easier and contributes the real time balancing. After day-ahead planning, day-ahead marketing move into the system in 2011. Finally associated with the EML (6446)Energy Markets Operation Corporation (EPIAS) was established in 2015 and its mission is stated as fallows at the site[12]: “Lead development of energy market through managing it in an effective, transparent and reliable manner; provide reliable reference price formation by means of sharing the market knowledge fair-and-square; create added value to national

economy wherethrough maximizing the trading volume." Turkey electricity market restructuring process is shown in the Fig. 6.

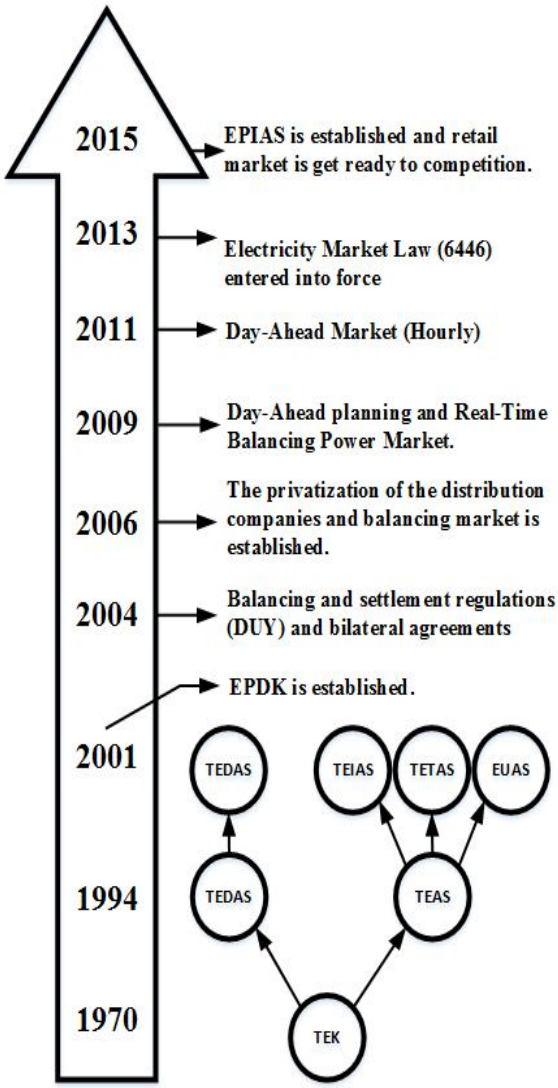


Fig.6. Turkey electricity market development process

IV. FINANCIAL MARKET ORGANIZATION IN TURKEY

Transmission, distribution, trade of electricity and redressing the imbalances are managed by rules of EPIAS. There are three financial market operations in EPIAS which are day-ahead market (DAM), intraday market (IM) and balancing market (BM). In this section, it is discussed the financial market operation.

4.1. Day-Ahead Market

DAM provide an opportunity buying and selling of energy for day ahead in addition to the bilateral contract made by market participants.It also ensures the energy balance in the market.The supply/demand offers by producers/consumers are considerate in order to determining market equilibrium price (PTF).The market participant offers can be hourly, block or flexible and can be Turkish Liras, USD or Euro.The PTF protects the market participant from fluctuating energy prices. The offers can be made both for buying or selling. Provided that the offer is buying/selling, its sign is negative/positive. Table 1 is presents the supply/demand offers by market participant A, B. C. D as a sample and calculated PTF is shown in Fig.7.

Table1: A sample supply/demand offers in DAM

Price (TL/MWh)	A	B	C	D	Total Purchase (MWH)	Toplam Sale (MWH)
0	100	40	150	60	350	0
15	100	40	150	60	350	0
30	70	40	80	10	200	0
45	70	40	0	10	120	0
60	30	40	0	-20	70	-20
75	30	40	-40	-20	70	-60
90	-30	40	-60	-20	40	-110
105	-30	40	-100	-40	40	-170
120	-50	40	-100	-40	40	-190
135	-50	40	-170	-130	40	-350
2000	-50	40	-170	-130	40	-350

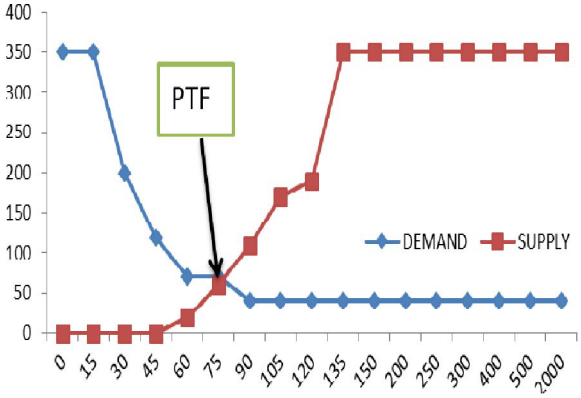


Fig.7. Calculated PTF from supply/demand offers in Table 1.

Financial market organization is performed by EPIAS in Turkey as previously discussed in Section 3.The calculated PTF by EPIAS for following day is shown in Fig.8 [12].

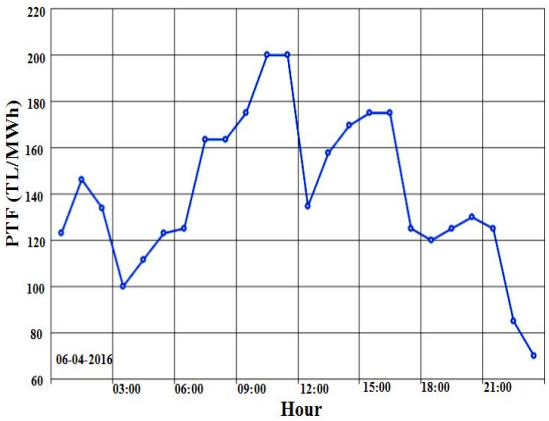


Fig.8.Hourly calculated PTF in real system

4.2. Intraday Market

In order to eliminate the energy unbalancing and provide the trade area in intraday, IM is implemented in market. Thanks to IM, market participants use their capacity that is not used in DAM. Also,the trade volume and balancing density decrease in BM, so that it is closer to the real-time balancing.IM operation based on hourly. The highest offer is the priority for buying energy, the lowest price is the priority for sellingenergy.The IM statistic in 2016 is presented in Fig.9. [12].

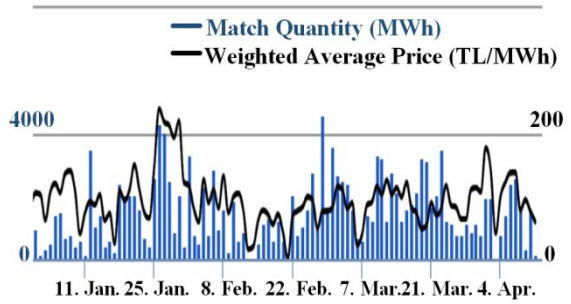


Fig.9. Intraday market statistic in 2016 by EPIAS

4.3. Balancing Market

Real time principal balancing is carried out in the balancing market (BM). The goal of BM is to eliminate the frequency oscillation caused by the failures in producer or consumer side. BM is not implemented in real time balancing forenergy trade.Although DAM created the balance for next day in market, balance of market is disturbed due to intraday deviation.When there ismarket imbalance, Central Load Dispatch Center evaluates the offer by BM and try to keep the balance of market. Provided that system frequency below the 50Hz meansthere is more consumption in system compared to the production, the system have to shed load or increase production in order to provide the balance. In the same way, when system frequency is above the 50Hz, a production more than consumption exists in the system, the system have to take load or decrease production to provide the balance. In order to provide the balance, it is implemented the load shedding or taking on the specific price discussed next section “system marginal price”.

4.3.1. System Marginal Price in BM

The lowest load taking (LT) offers is preferred when there is more consumption in the market. On the contrary, when there is more production in the market, the highest load shedding (LS) offers is preferred respectively. System marginal price (SMP) is the last offer leading the completion of net trading volume.

SMP is calculated 140$ when lack of energy is 600MW. In the same way provided that the system have excess energy (350 MW), SMP is calculated 65$. System marginal price of Turkey in 2016 is presented in Fig.10. [12].

Table2: Calculate the system marginal price in BM

Load Taking Bids		Load Shedding Bids	
Price (TL/MWh)	Quantity (MW)	Price (TL/MWh)	Quantity (MW)
200	100	90	100
190	50	85	50
180	160	75	80
140	180	70	70
130	250	65	100
120	100	40	50
115	150	20	100



Fig.10. System marginal price in 2016 by EPIAS

CONCLUSIONS

The market restructuring has been continuing more than 30 years. In this paper, Turkish electricity reform and current market structure is discussed. Considering the current market structure in Turkey, some issues show great importance in order to improvethe market structure which can be listedasfollows:

- More attractive energy tariffs should be submitted for small residential customers
- A more detailed renewable legislation should be establishedfor residential customersowning renewable energy
- The demand response application in smart gridshould be expanded.
- Apricing infrastructure considering demand flexibility should be created.
- Hourly pricing program should be adopted
- Load forecasting that incorporates the impact of demand flexibility should be developed.

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