A paper on the unsettled question of Turkish electricity market: Balancing and settlement system (Part I)

Erdogdu, Erkan

Energy Market Regulatory Authority, Republic of Turkey

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Erkan Erdogdu[a,b,*]

[a]*Energy Market Regulatory Authority, Ziyabey Cad. No:19 06520 Balgat/ANKARA TURKEY*

Abstract

Turkish Electricity Market Law (EML) came into force in 2001 aiming at establishing a financially strong, stable, transparent and competitive electricity market based on bilateral contracts. Also, a balancing and settlement system (BSS) was put into practice in November 2004 to create a market where uncontracted generation can be traded, and actual implementation of the BSS started on August, 1st 2006 following a 21-month virtual implementation period. However, BSS has always been criticized from its beginning as transferring excessive profits to private generation companies. The present paper analyzes the implementation of BSS and argues that current BSS not only undermines the healthy development of the electricity market in Turkey but also prevents power investments due to uncertainties it created. It concludes that since the inconsistency between the objectives of EML and results of BSS in practice is obvious, Turkish policy

[*] Corresponding author. Tel.: +90-312-2872560 Fax: +90-312-2878819
E-mail: erkan@erdogdu.net
URL: http://erkan.erdogdu.net/english

[b] The author is working as an Energy Expert in Energy Market Regulatory Authority of the Republic of Turkey. In October 2005, the author is awarded an "MSc with Distinction in Energy Economics and Policy" by the Department of Economics, University of Surrey (UK).

makers need to modify current electricity market policy in line with suggestions presented in the paper.

Keywords: *Balancing and settlement; Turkey; electricity wholesale market*

1. Introduction

On March 3, 2001, Electricity Market Law (EML, No. 4628) came into force and aimed at establishing a financially strong, stable, transparent and competitive electricity market in Turkey. In line with new law, vertically integrated Turkish electricity corporation (TEAS) was restructured to form three new state-owned public enterprises, namely Turkish Electricity Transmission Co. (TEIAS), Electricity Generation Co. (EUAS) and Turkish Electricity Trading and Contracting Co. (TETAS). The new law also created an autonomous regulatory body. So, a major electricity market reform program was initiated in Turkey. The reform program entails privatization, liberalization as well as a radical restructuring of the whole electricity industry. EML includes the following key elements [1]:

- An autonomous Energy Market Regulatory Authority (EMRA), governed by its independent board,
- A licensing framework for market participants,
- An energy market based on bilateral contracts between market participants,
- Eligible consumer concept to ensure freedom for eligible consumers to choose their suppliers.

The views, findings and conclusions expressed in this article are entirely those of the author and do not represent in any way the views of any institution he is affiliated with.

EMRA has started to work immediately after its appointment on November 19, 2001. In March 2004, Turkish High Planning Council adopted Electricity Sector Strategy Paper with a road map aiming at sector reform. According to the 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 uncontracted 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*".

As referred in Strategy Paper of March 2004, one of the primary components of this reform process is what is called "balancing and settlement system" (BSS), referring to a system consisting of activities related with real-time balancing the demand and supply through acceptance of bids and offers, financial settlement of payables and receivables arising from energy supplied to or withdrawn from the system. BSS was put into practice on November 3rd, 2004 by a regulation published in Turkish Official Gazette No. 25632. However, actual implementation of the system started on August, 1st 2006 upon an EMRA decision (dated July 20th, 2006, No.831) following a 21-month virtual implementation period. However, BSS has always been criticized from its beginning as transferring excessive profits to private generation companies. Although there exists a huge literature on electricity wholesale markets; to the best of our knowledge, so far, no scholar has studied and

analyzed Turkish electricity wholesale market in general and Turkish balancing and settlement system in particular. The present paper aims at filling this gap in the literature. Since it is obvious that BSS will have important implications for the future of the reform process, the present article constitutes an important contribution not only to the existing literature but also to the electricity market policy formulation process in Turkey.

The paper is organized as follows. The next section presents theoretical fundamentals. Section 3 provides an overview of current balancing and settlement system in Turkey. Section 4 critically analyzes the balancing and settlement system in Turkey and lists some policy suggestions to improve current framework. The final section concludes.

2. Theoretical fundamentals

Terms such as “pools”, “power exchanges”, “spot-markets”, “day-ahead markets” and so on are many different ways of classifying the prevailing concepts of wholesale electricity trading. Generally speaking, electricity market models can be classified into two broad categories: single-price market models and dual price market models. In single-price markets, there is only real time balancing market and bilateral contracts market rarely exists. On the other hand, in dual-price markets, there are day-ahead market and real time balancing market in addition to bilateral contracts market.

2.1. Single-price market models

In single-price markets, there is only real time balancing market and bilateral contracts market hardly exists. Single-price markets bundle the energy transaction price with the energy transmission price in that a single price for energy delivered (or produced) including all system operation costs. In dual-price markets on the other hand the price for the commodity (the energy transacted) is separated from the price/cost of the transmission and system operation. Single-price market concepts are in nature unit-oriented and centrally dispatched, and are the closest to pre-deregulation electricity structures.

Criticisms of single-price markets often point out the lack of demand-side participation. This is due to the absence of a day-ahead price signal that is required for industrial and commercial load in order to plan load curtailment. The single-price markets are used in developing countries where the government needs to have strong control of the generation and transmission assets – such as most Latin-American countries. With little demand-side response and centrally controlled utilization of governmental or private owned generation assets, controlled pricing and tariffs plays a very important role. Examples of single-price markets are the Alberta and Ontario markets; the majority of the Latin-American markets – Brazil, Chile, and Argentina; New Zealand and Australia, Korea and Singapore. Examples of single-price markets with bilateral contracts are Texas market – ERCOT, and the new UK market NETA/BETA.

2.2. Dual-price market models

In dual-price markets, there are day-ahead market and real time balancing market in addition to bilateral contracts market and the price for the commodity (the energy transacted) is separated from the price/cost of the transmission and system operation. Dual-price market model can be further classified as centrally dispatched dual-price price markets and self-dispatched dual-price markets.

Centrally dispatched markets are characterized by a close integration between system operation and the electricity markets. In most cases, the system and market operator are the same organization. In this respect these markets resembles the single-price markets to a large extent. However, these models employ more market features such as forwards and day-ahead markets; and markets for various ancillary services. The argued benefit of such models is that it is the – at least in theory – the most cost-effective structure, since a centralized, independent entity utilizes all units in the most optimal manner. The criticism towards such markets is towards the complexity and cost of the construct. Examples of this concept are the US markets; PJM, New York, New England, Midwest ISO and California.

In self-dispatched markets there is a clear separation between the market operator and the system operator. The market operator organizes various kinds of markets for energy transactions, such as derivatives/forwards, day-ahead and intra-day markets. The system operator is not concerned by the contractual transaction of energy – although need to have information of the

contracted schedules; but is responsible for electricity balancing and for system reliability and security. The system operator will, in most cases, operate markets for some of the required ancillary services such as balancing power and capacity reserves.

With unit-based markets is meant that the energy bids and offers are directly related to physical units (generating units and load units/aggregates). In addition to the energy offers and bids (e.g. price per MWh willing to produce or consume), the market participants must submit parameters describing operating conditions for the units; such as minimum runtime, ramp rates, startup costs etc. The market operator will use these parameters when calculating the market clearing price and corresponding schedules. Examples of unit-oriented markets are Spain/Portugal, Italy and Japan.

The most decentralized market structure is a fully portfolio-based concept. Here the market participants transact energy on long-term or day-ahead based on their total energy portfolio. The market structure requires that all market participants connected to the central grid as controlled by the system operator have a balanced portfolio. This implies that for each participant own generation and procurement must balance the sum of consumption and sales. The market operator has no interest or influence in the actual unit commitment and scheduling of individual units – that is left to the market participants to handle. Contracts concluded in the day-ahead market are binding, and although the system operator can not change the day-ahead schedules, any deviations from the contracted schedules and real-time operation will be rebalanced by the system operator. Any real-time deviation

or system operational issues are handled by the independent system operator(s), which may organize separate markets for procuring balancing power, capacity reserves and other ancillary services. Examples of this market structure are the prevailing European markets; including NordPool, France, Germany, Austria, Poland, Slovenia and Romania. Emerging markets such as South Africa countries seems to lean towards this concept.

Figure 1 presents the classification of electricity market models, current Turkish model and final targeted model[1]. Turkey aims at transforming its current single price market with bilateral contracts into a portfolio based self-dispatched dual price electricity market.

[Figure 1 goes here]

Streckiene et al. [2], Rabiee et al. [3], Diongue et al. [4], Druce [5], Lee and Lee [6], Cuaresma et al. [7] present different implementation of electricity market models around the world.

3. Current balancing and settlement system in Turkey

The final Turkish electricity wholesale market is expected to consist of (1) bilateral contracts markets between the market participants, (2) an organized day-ahead market, operated by market operator (TEIAS/MFSC), (3) a real-time system balancing and operational mechanism by the system operator (TEIAS/NLDC), (4) an organized market for financially settled electricity contracts, (5) one or more organized markets for procurement of ancillary

services. Table 1 compares current and expected Turkish wholesale electricity market structures.

[Table 1 goes here]

In Turkey, National Load Dispatch Center (TEIAS/NLDC) is the unit under the body of TEIAS in charge of real-time balancing of electricity demand and supply. Market Financial Settlement Center (TEIAS/MFSC) is another unit of TEIAS that operates the settlement side of balancing and settlement system by calculating amounts payable or receivable by legal entities operating in the market, based on differences between actual purchases and sales as a result of the real time physical balancing of energy supply and demand by TEIAS/NLDC.

At present, the market participants are composed of licensed legal entities that supply energy to the system or withdrawn energy from the system through participating in the balancing mechanism and/or their short and/or long energy positions. Current market participants include:

- Generation licensees,
- Autoproducer and autoproducer group licensees,
- Wholesale licensees,
- Retail licensees.

The market participants are obligated to register with TEIAS/MFSC within one month following the effective date of their licenses. TEIAS/MFSC is authorized as the market operator and TEIAS/NLDC as the system operator.

Balancing mechanism participants submit separate bid and offer prices for each settlement period (daytime, peak and night) twice a month. Until 14:30 every day, they are also required to present physical notifications covering the 24 (twenty four) hour period between 00:00 and 24:00 hours before the day physical notifications are made for. Balancing of demand and supply for day ahead scheduling activities and real time is achieved by evaluation of bids and offers and acceptance of appropriate bids and offers by TEIAS/NLDC. The bids and offers are evaluated with regard to the following criteria:

- Transmission and distribution constraints,
- Technical constraints of balancing mechanism entities,
- Bid and offer prices submitted for balancing mechanism entities.

Bids and offers that are accepted by TEIAS/NLDC are transformed into the corresponding loading and de-loading instructions and issued to relevant balancing mechanism participants.

The current day ahead scheduling process realized by the system operator is described above; however, due to space limitations, projected market structure for the final Turkish wholesale electricity market is presented in Figure 2 [8].

[Figure 2 goes here]

4. Critical analysis and policy suggestions

It seems that Turkey targets self-dispatched and portfolio based dual price market model as the final market design of her wholesale electricity market and will continue to modify its current model in line with final target. The reasons for the selection of this model may be summarized as follows. First of all, global experience from various markets strongly indicates that demand side participation and demand side price elasticity is far more developed in decentralized market models based on self-scheduling than centrally dispatched markets. Second, price calculation in portfolio-based markets with one or few market prices is much easier to verify and understand by the market participants. Third, local optimization of own resources promotes innovation and better utilization on the market participant level, as opposed to on a national level. In a competitive market, it's important to emphasize on the market participants maximum ability to utilize and handle their own resources by clever planning, operation and investments. Fourth, portfolio-based market structure leads naturally into derivatives markets for risk management. Since the day-ahead market is portfolio (e.g. contract) based, the risk aspect is also more "contract" based, and it's thus easier to design standard products in the forwards markets. Fifth, simplicity and transparency in calculating the market clearing prices will be important to establish confidence to the market among the participants. Price determination is based on fundamental economic concept of intersection of supply and demand curves which is easy to explain and understand for everybody. In the initial phases of the market, one may assume that the participants will have limited experience and resources to handle complex pricing and trading

rules, so simplification of pricing calculation is an important issue. Sixth, dual price, i.e. introduction of day ahead market, incentivizes demand side participation in the market which ultimately will lead to price stability and contribute to security of supply. Seventh, portfolio based self-dispatch will provide a tool for market participants to trade for balance before the delivery time. Accordingly, this will provide a comfortable environment for the system operator to manage system and to balance only real-time deviations. And finally, this market model is a proven one in prevailing European countries.

As we know in a competitive market an increase in demand is followed by a corresponding increase in supply; that is, seasonal price increase caused by supply shortages result in an increase in investment, which in turn provides an increase in supply, a decrease in price and finally price stability. In short, price is expected to follow demand in competitive markets. So, price increase is unavoidable if supply is fixed while demand increases. In electricity markets, however, supply is almost fixed in short and even medium terms as power investments require a long time span to complete. Therefore, demand forecasts are crucial in electricity markets. Without healthy and accurate estimates that project any demand increase at least 5 years ago, it is almost impossible to prevent price increases in any electricity market based on free competition. This is where actually problem lies in Turkey.

In Turkey, supply shortages leads to electricity purchases in balancing market (a kind of spot market[2]) by system operator within balancing and settlement framework as described in previous sections. Since in Turkey demand forecasts are not reliable[3], necessary investments could not be done

and even at present level of investment is not high enough to cover present and future demand. So, frequently, Turkish system operator is forced to purchase electricity from spot market, which together with actual implementation of balancing and settlement system directly results in high prices. Table 2 presents the evolution of wholesale prices in Turkish electricity market in national currency (YKr/kWh) since the beginning of actual implementation of balancing and settlement system [9]. In Table 2, system imbalance price is the weighted average of hourly system marginal prices for each settlement period (daytime, peak and night) in a month; and Turkish average electricity wholesale price is a reference price determined by EMRA that is used in determination of retail electricity prices.

[Table 2 goes here]

Figure 3 shows the evolution of wholesale prices in Turkish electricity market in national currency (YKr/kWh). As can be seen in Figure 3, system imbalance price is almost always higher than the Turkish average electricity wholesale price. The difference between spot price and average electricity wholesale price is reflected in accounts of public distribution (TEDAS) and wholesale companies (TETAS) as a loss. Government accepts these losses to keep electricity prices low.

[Figure 3 goes here]

Another vital result of the actual implementation of balancing and settlement system is the fact that it caused an important decrease in the volume of

bilateral contracts. Since prices emerged in spot market are mostly higher than those determined between private parties (that is, between buyers and sellers), private generation firms have preferred to cancel their power sale agreements and sell electricity they produced in spot market. As can be seen in Figure 3, system imbalance price was about 11-13 YKr/kWh in August 2006 when balancing and settlement system was initiated. In the course of time, price increased by more than 35% and exceeded 18 YKr/kWh. Therefore, most private generators prefer to sell their electricity in spot market rather than to a private third party. Table 3 and Figure 4 demonstrate the evolution of the share of bilateral contracts in total electricity transactions in Turkish wholesale market from September 2006 to May 2008. Figure 5 on the other hand illustrates the evolution of transactions based on bilateral contracts [9].

[Table 3 goes here]

[Figure 4 goes here]

[Figure 5 goes here]

Figure 4 and Figure 5 clearly indicate that there exists a decrease in the volume of electricity trade based on bilateral contracts in both actual and relative terms. The share of transactions based on bilateral contracts within total transactions decreased about 50% and actual trade volume based on bilateral contracts reduced by 38%. Moreover, the number of connection points based on bilateral contracts (that is the number of eligible consumers

actively taking part in the market) decreased almost by one fourth! (from 799 to 215). So at present Turkish market seems like a pool model with a single buyer rather than a competitive market with bilateral contracts.

Within this context, there is another interesting point to mention. In Turkey, power generation from renewable sources are encouraged and the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (Law no. 5346, dated 10 May 2005) lets purchasing of electricity from renewable energy sources with a higher price. According to it, until the end of 2011, the applicable price for the electricity produced from renewable sources is between 5 and 5.5 Eurocent/kWh [10]. However, since even this subsidized price[4] is about 35% below the one emerged in spot market, private power plants based on renewable sources prefer to sell electricity they produced in spot market. This situation illustrates how high the prices are in the spot market.

At this point, let me focus on the apparent conflict between new Electricity Market Law (EML, No. 4628) that aims at establishing a competitive electricity market based on bilateral contracts and current balancing and settlement system (BSS) that causes the number of bilateral contracts to radically decline. Current BSS undermines the objectives specified in EML by preventing bilateral trading as specified above. If continued to be implemented unaltered, BSS will eliminate almost all private electricity sale agreements in less than a year.

Actually, Turkey faces a dilemma. On the one hand, she is not able to increase the level of electricity investments due to reasons mentioned elsewhere [11]. However, on the other hand, she also desires not to implement any power cut while demand rises. Among the apparent results of this dilemma are rising prices and supply shortages. Furthermore, a true competitive market based on bilateral trading requires a surplus capacity that is open to negotiation among buyers and sellers. But in Turkish case although there exists a supply shortage (let alone surplus capacity!), Turkey still tries to set up a market based on bilateral trading! To be at least consistent, Turkey has following two options. First, Turkey continues to implement existing BSS but accepts to pay for high electricity prices. In such a case, she must also be ready to convert its market structure into one based on a pool with single buyer. Second, Turkey gives up current BSS to avoid high prices but in this case she should implement some power cuts at least in the short run to compensate for the supply shortage. The best option for Turkey may be the following. In the short run, Turkey determines a maximum price expressed as a percentage of Turkish average electricity wholesale price (TAEWP) that specifies the upper limit of BSS prices. For instance, it may be stated that BSS prices cannot exceed 150% of TAEWP. If BSS prices are within this limit, Turkey continues to implement BSS. When they exceed the limit, Turkey implements power cuts within a program. In this option, Turkey needs temporarily to convert its market model into pool model with single buyer. In the medium and long term, Turkey should encourage power investments in a large scale and when a surplus capacity is created she should abolish upper limit for BSS prices immediately and transform its market into competitive one with bilateral trade. Nuclear power plant projects

with capacities expressed in thousand MWs are perfect candidates for investment options for Turkey [12]. While implementing such a policy, Turkey should keep in mind the final aim of creating a competitive market where private parties freely trade electricity. Therefore, she should avoid public investments and any means that may result in an increased activity of public firms in the market.

Since we offer a pool model for Turkey in the short term and a competitive market based on bilateral contracts in the medium and long terms let me focus on the perceived advantages and disadvantages of both the pool and the bilateral contract models of power trading. A competitive electricity pool is often created on the basis of an existing cooperation agreement between various utilities. Its conversion to operation on a competitive basis will therefore be less of a revolution than the creation of a completely new structure. Some of the concerns that accompany the introduction of competition may be alleviated by the somewhat less radical nature of the change. A pool provides a much more centralized form of system management. Not only does it handle all the physical electricity transactions but it usually also assumes the responsibility for operating the transmission system. This combination of roles avoids the multiplication of organizations but makes it more difficult to distinguish between the various functions that need to be performed in an electricity market. Moreover, most small and medium electricity consumers have very little incentive to take an active part in an electricity market. Even when they are aggregated, the retailer that represents them has no direct means of adjusting consumption in response to changes in prices. One might therefore argue that the transaction costs

could be reduced significantly if the demand is deemed to be passive and is represented by a load forecast in an electricity pool. Actually we are unhappy with this approach because we feel that direct negotiations between consumers and producers are essential if efficient prices are to be reached. We strongly propose that the pool model should ultimately be replaced by a competitive market simply because pools are only administered approximations of a market and not true markets. Furthermore, pools also provide a mechanism for reducing the scheduling risk faced by generators and hence, hopefully, the cost of electrical energy. When a generator sells energy on the basis of simple bids for each market period separately, it runs the risk that for some periods it may not have sold enough energy to keep the plant on-line. At that point, it must decide whether to sell energy at a loss to keep the unit running or to shut it down and face the expense of another start-up at a later time. Either option increases the cost of producing energy with this unit and forces the generator to raise its average bid price. If this generator trades in a pool that operates on the basis of complex bids, the rules of this pool probably ensure that it recovers the start-up and no-load components of its bid. Besides, the scheduling algorithm implemented by the pool usually tries to avoid unnecessary shutdowns. Since these factors reduce the risks faced by the generators, one would expect that they should foster lower average prices. This reduction in risk, however, comes at the price of an increase in the complexity of the pool rules. More complex rules reduce the transparency of the price setting process and increase opportunities for price manipulations. In practice, it is not clear whether complex bids and pool-based scheduling actually lower electricity prices.

5. Conclusion

Since the inconsistency between the objectives of EML and results of BSS in practice is obvious, Turkish policy makers need to modify current electricity market policy. As in the case in any policy, Turkish energy policy should save not just today but also the future. Current system may prevent power cuts today but who can answer the following question within current framework: *Imagine that a new 3,000 MW nuclear power plant is constructed; will it sell electricity it generated in balancing market? Or, do private investors invest in such a power plant by just depending on volatile and unpredictable BSS prices?* In short, current system undermines the healthy development of the electricity market in Turkey and prevents power investments due to uncertainties it created. We offered a solution to this problem in previous section. This or any other consistent model should replace current inconsistent one as soon as possible.

The energy industry is a complex one; and the creation of a wholesale market for electricity, where none previously existed, is no easy task. Not surprisingly, there will be problems but most of them will disappear with the growth of more effective competition. If reforms are practiced by taking into account their underlying economic logic, there is no reason not to believe that the domestic and foreign investors will be greatly interested in entering a market with excellent growth potential, like Turkish power market.

As no meaningful competition has developed so far in Turkish wholesale market, a significant amount of work still lies ahead. It should not be forgotten

that the true test of success comes in the form of whether a structure in which generators, suppliers, customers and other actors in the market can all freely negotiate, each taking their own view of the prices, risks, opportunities and threats that a competitive market offers is created or not.

References

[1] Erdogdu, Erkan 2007. Regulatory reform in Turkish energy industry: An analysis. Energ Policy 35(2): 984-993.

[2] Streckiene, G., Martinaitis, V., Andersen, A.N., Katz, J. 2009. Feasibility of CHP-plants with thermal stores in the German spot market. Applied Energy 86(11): 2308-2316.

[3] Rabiee, A.,Shayanfar, H., Amjady N. 2009. Multiobjective clearing of reactive power market in deregulated power systems. Applied Energy 86(9): 1555-1564.

[4] Diongue, A. Guégan, D., Vignal, B. 2009. Forecasting electricity spot market prices with a k-factor GIGARCH process. Applied Energy 86(4):505-510.

[5] Druce, D.J. 2007. Modelling the transition from cost-based to bid-based pricing in a deregulated electricity-market. Applied Energy 84(12): 1210-1225.

[6] Lee, C., Lee, J. 2009. Energy prices, multiple structural breaks, and efficient market hypothesis. Applied Energy 86(4): 466-479.

[7] Cuaresma, J.C., Hlouskova, J., Kossmeier, S., Obersteiner, M. 2004. Forecasting electricity spot-prices using linear univariate time-series models. Applied Energy 77(1): 87-106.

[8] EMRA (Energy Market Regulatory Authority) 2008. Electricity Market Balancing and Settlement Regulation. Accessed from http://www.epdk.org.tr on 26.12.2008 at 12:18.

[9] TEIAS/MFSC (Market Financial Settlement Center) (2008). Reports. Ankara, 2008, accessed from http://pmum.teias.gov.tr on 26.12.2008 at 16:13.

[10] Erdogdu, Erkan 2008. An expose of bioenergy and its potential and utilization in Turkey. Energ Policy 36(6): 2182-2190.

[11] Erdogdu, Erkan, 2005. Energy Market Reforms in Turkey: An economic analysis. MSc Dissertation, Department of Economics, Surrey University, Surrey, UK, September 2005.

[12] Erdogdu, Erkan 2007. Nuclear power in open energy markets: A case study of Turkey. Energ Policy 35(5): 3061-3073.

[13] Erdogdu, Erkan, 2007. Electricity demand analysis using cointegration and ARIMA modelling: A case study of Turkey. Energ Policy 35(2): 1129-1146.

Further Reading

Bunn, D.W. (Ed.) 2004. Modelling Prices in Competitive Electricity Markets. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.

Kirschen, D., Strbac, G. 2004. Fundamentals of Power System Economics. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.

Stoft, S. 2002. Power System Economics: Designing Markets for Electricity. IEEE Press & Wiley-Interscience.

Footnotes

[1] The technical information in this section is collected from various books, papers and notes that are published or not.

[2] Current balancing market might be regarded as a “managed spot market”. This mechanism is a market because the energy that is used to achieve the balance is freely offered by the participants at a price of their own choosing. It is a spot market because it determines the price at which imbalances are settled. However, it is also a managed market because the bids and offers are selected by a third party (the system operator) rather than through bilateral deals.

[3] For more information on electricity demand forecasts in Turkey, see [13].

[4] 5.5 Eurocent equals to about 11.5 YKr at current exchange rates.

Captions to Tables

Table 1. Current and expected Turkish wholesale electricity market structure

Feature	Current Market	Projected Market
Demand-Side Participation	No	Yes
Bilateral Contracts Market	Yes	Yes
Day-Ahead Operation	Day-Ahead Planning by System Operator (NLDC)	Day-Ahead Spot Market (DAM)
Day-Ahead Participants	Big generators only (mandatory)	All generators, Wholesalers, Retailers, Eligible Consumers, Autoproducers, Industrial Load (Voluntary)
Real Time Balancing	Yes	Yes
System Imbalance Price (SIP)	Weighted Average of Hourly System Marginal Prices (3 prices/month)	System Marginal Price (Hourly)
Spot Price	SIP	Marginal Prices in Day-Ahead Market
Settlement Periods	Monthly	Hourly
Market Operator Operates	Settlement only	Day-Ahead Market, Forwards Markets and all Settlements
System Operator Operates	Day-Ahead Planning and Real Time Balancing Market	Real Time Balancing Market (Ancillary Services Market)
Financial Forwards Market	No	Yes

Table 2. Evolution of wholesale prices in Turkish electricity market (YKr/kWh)

Month	System Imbalance Price			Turkish Average Electricity
	Daytime	Peak	Night	Wholesale Price
January 2006	14,38	14,48	6,68	9,13
February 2006	8,85	10,55	7,59	9,13
March 2006	14,61	15,38	14,80	9,13
April 2006	5,67	6,81	5,77	9,13
May 2006	7,56	9,61	7,23	9,13
June 2006	8,69	9,89	7,96	9,13
July 2006	10,28	11,50	8,85	9,13
August 2006	14,13	13,26	11,13	9,13
September 2006	13,82	13,15	11,67	9,13
October 2006	9,98	9,69	9,85	9,13
November 2006	11,16	13,06	9,47	9,13
December 2006	11,19	15,99	7,41	9,13
January 2007	13,70	12,14	12,62	9,67
February 2007	12,89	12,25	10,97	9,67
March 2007	13,13	9,83	11,50	9,67
April 2007	13,90	12,99	13,03	9,67
May 2007	12,69	11,43	10,95	9,67
June 2007	14,64	14,25	12,50	9,67
July 2007	15,04	15,41	14,37	9,67
August 2007	14,53	15,92	11,40	9,67
September 2007	11,70	13,97	9,86	9,67
October 2007	9,89	11,80	6,85	9,67
November 2007	14,48	15,79	10,70	9,67
December 2007	14,82	16,70	11,40	9,67

January 2008	16,91	17,77	14,86	9,53
February 2008	17,05	17,70	15,38	9,53
March 2008	16,55	17,59	14,50	9,53
April 2008	16,62	17,58	13,39	9,53
May 2008	16,76	17,66	14,96	9,53
June 2008	16,56	17,74	12,92	9,53
July 2008	18,82	18,01	15,59	10,74
August 2008	18,32	18,17	15,46	10,74
September 2008	15,30	16,72	14,29	10,74
October 2008	14,28	17,02	8,98	14,39
November 2008	16,50	18,17	14,67	14,39

Table 3. Evolution of the share of bilateral contracts in total transactions

(September 2006 - May 2008)

	Number of Connection Units based on Bilateral Contracts	% in Total	Total Amount of Transactions based on Bilateral Contracts (MWh)	% in Total	Number of Total Connection Units	Total Amount of Transactions (MWh)
September 2006	799	58,6	1.259.223	10,2	1364	12.293.743
October 2006	592	51,5	1.057.216	9,1	1.150	11.659.127
November 2006	548	49,5	986.827	7,6	1.107	12.961.008
December 2006	518	48,2	1.010.064	7,3	1.074	13.906.275
January 2007	505	48,0	966.152	7,1	1.052	13.600.214
February 2007	495	47,3	829.330	6,6	1.046	12.567.699
March 2007	468	45,9	966.398	7,1	1.020	13.571.828
April 2007	464	45,4	959.295	7,4	1.022	12.944.182
May 2007	338	37,7	948.410	7,2	897	13.087.525
June 2007	329	37,0	942.218	7,0	889	13.513.351
July 2007	294	34,6	950.071	6,3	850	15.160.019
August 2007	287	34,0	923.582	6,0	843	15.356.342
September 2007	279	33,6	852.954	6,3	831	13.520.241
October 2007	271	32,8	800.857	6,3	826	12.807.364
November 2007	243	30,5	750.425	5,4	796	13.879.871
December 2007	239	30,1	700.618	4,8	793	14.546.282
January 2008	234	30,0	652.371	4,2	780	15.556.901
February 2008	231	29,8	644.308	4,5	775	14.349.853
March 2008	225	29,3	781.713	5,5	768	14.167.493
April 2008	?	-	?	-	?	?
May 2008	215	28,4	786.506	5,6	758	14.112.750

Figure Captions

Figure 1. Electricity market models

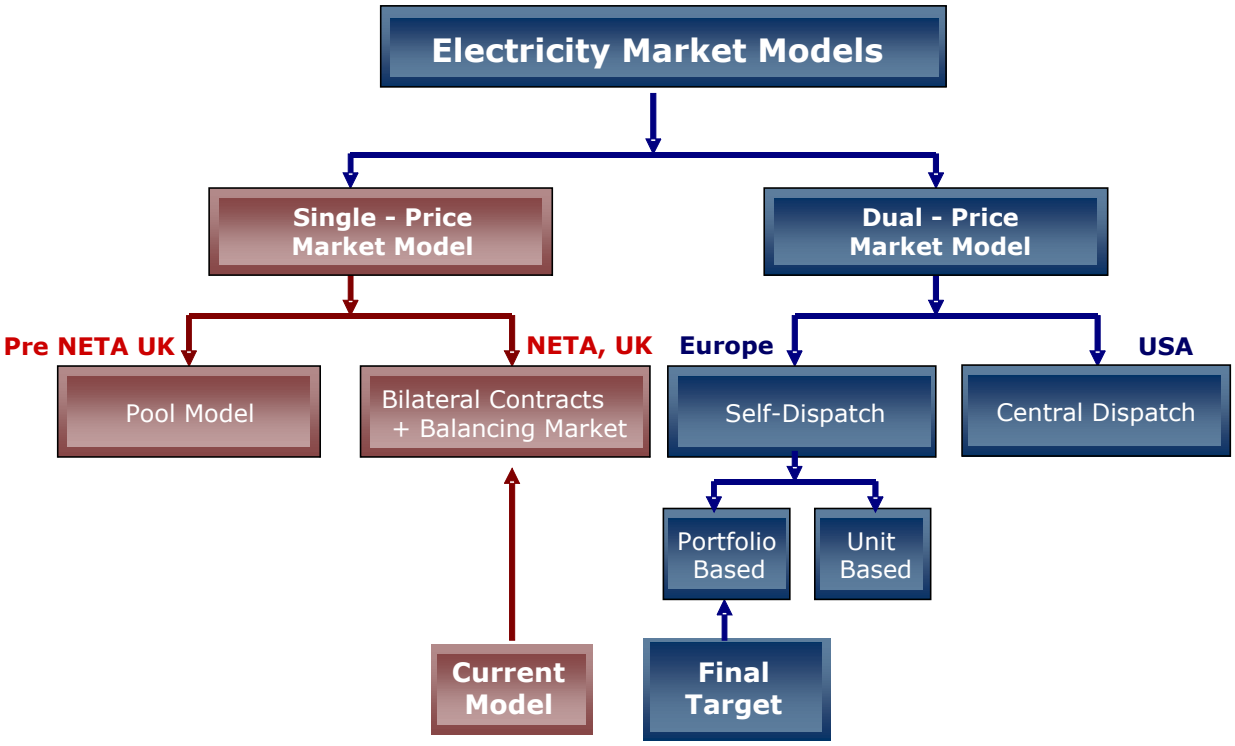

Figure 2. Projected market structure for the final wholesale electricity market in Turkey

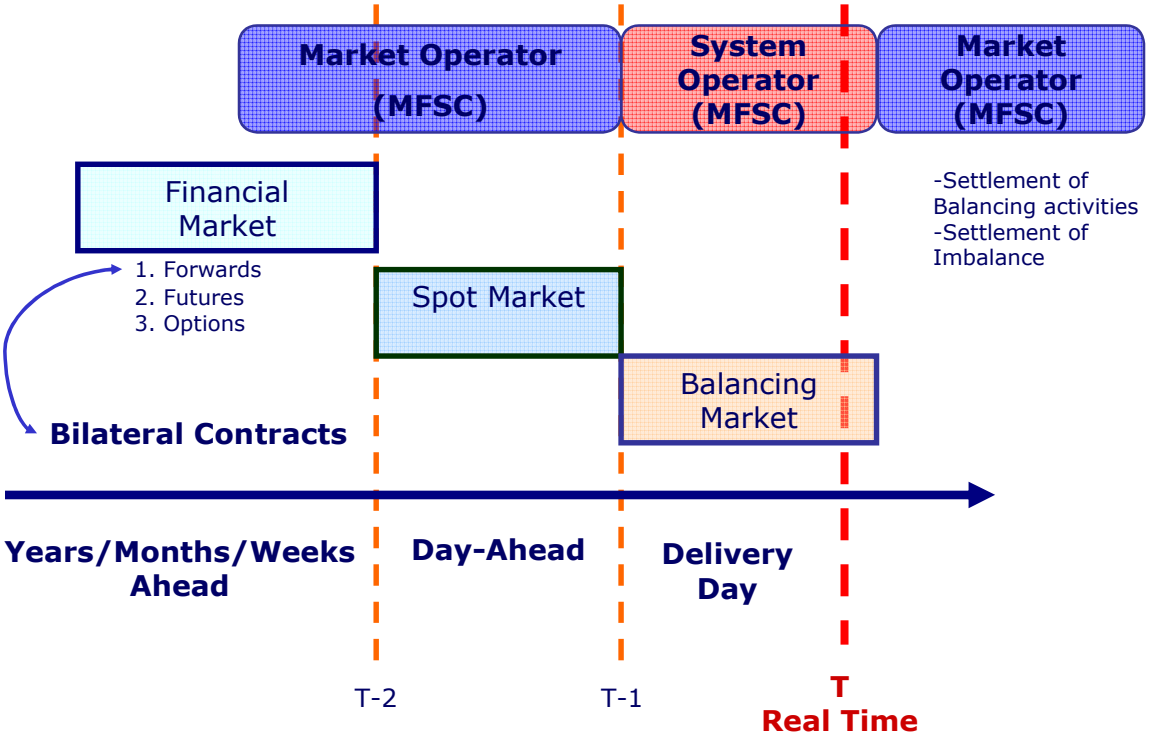

Figure 3. Evolution of wholesale prices in Turkish electricity market (YKr/kWh)

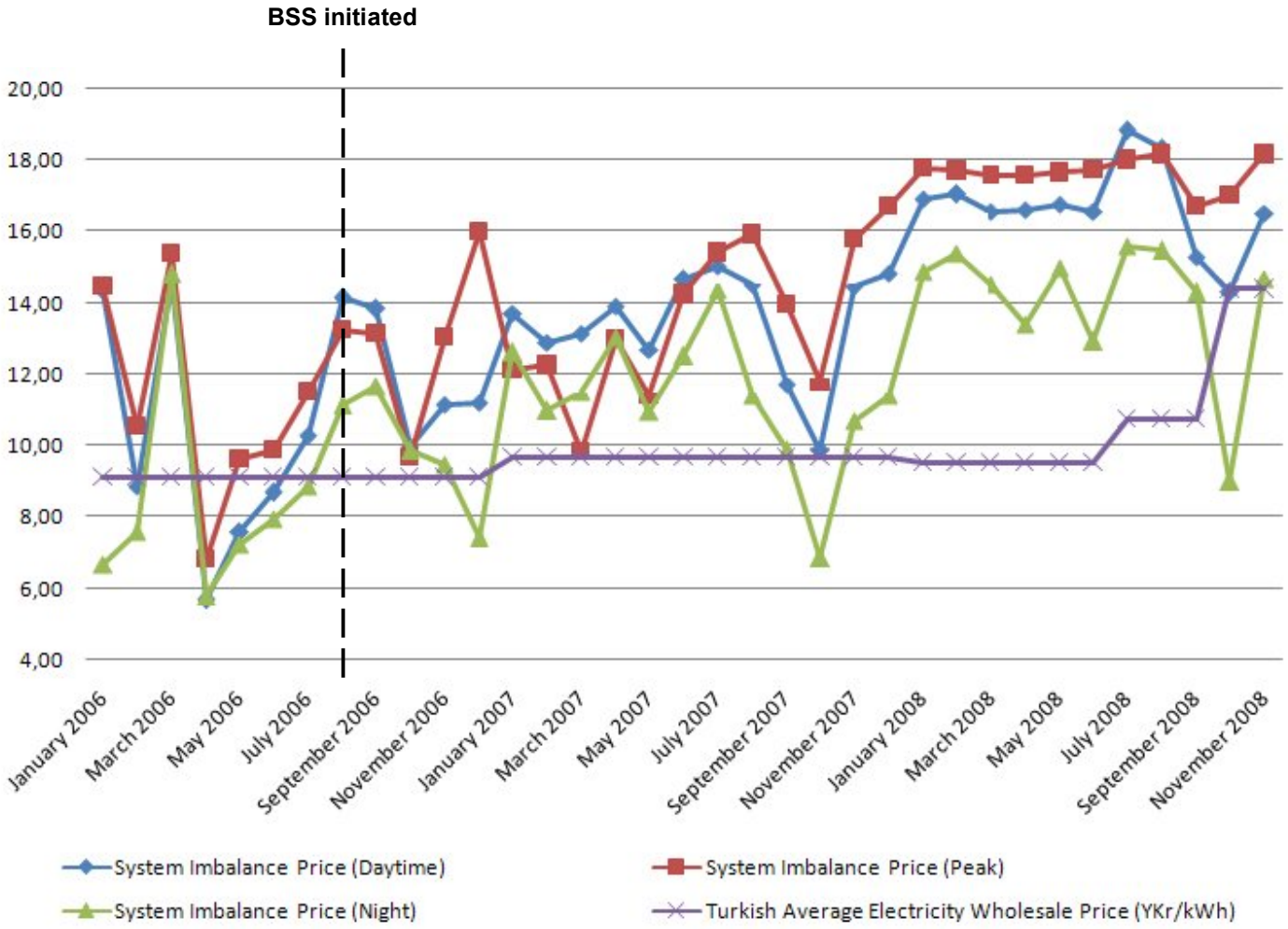

Figure 4. Share of transactions based on bilateral contracts within total transactions (%)

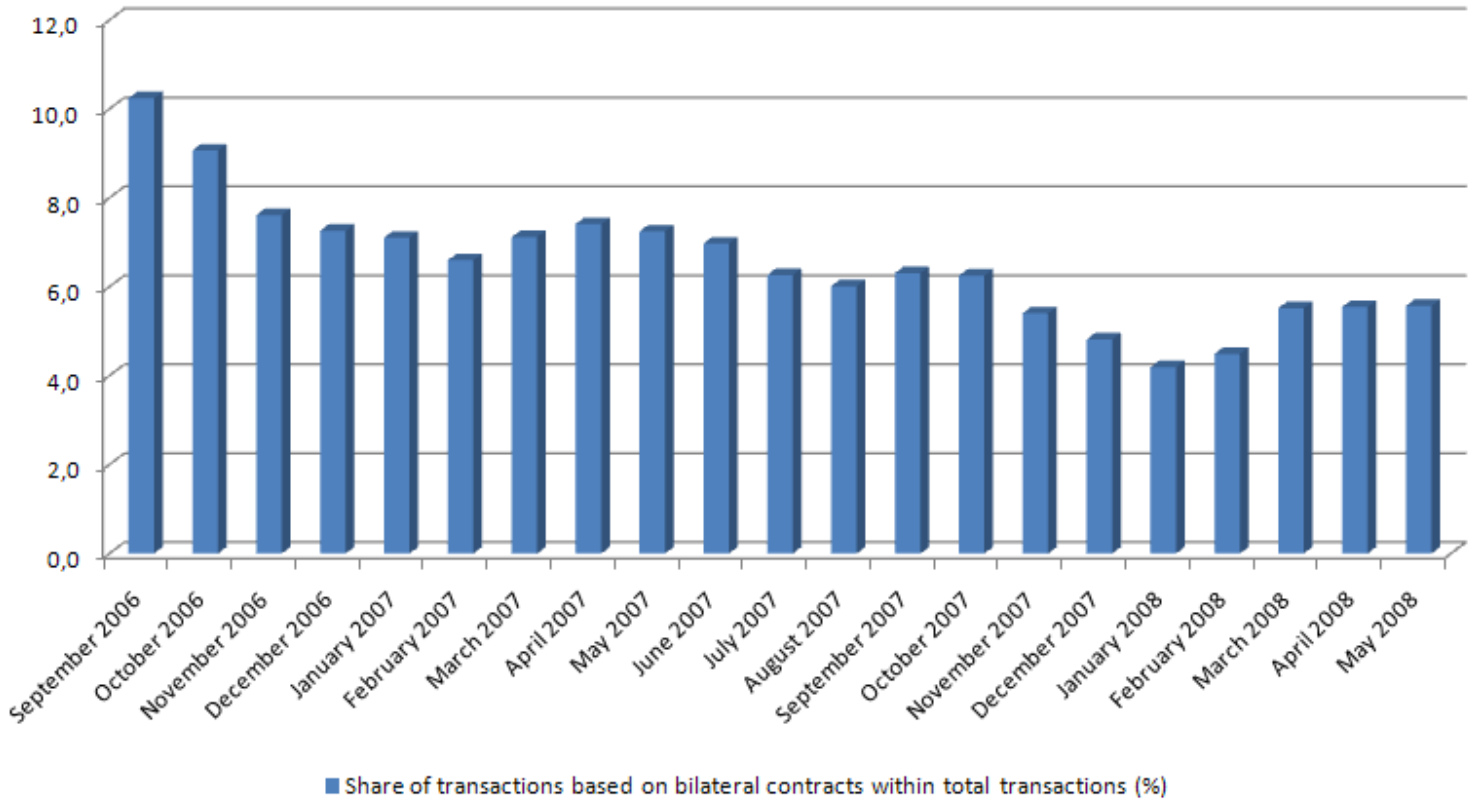

Figure 5. Evolution of transactions based on bilateral contracts