Electric Power Restructuring in Turkey

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***Abstract*—This paper presents the current status of Turkey's electricity power sector, efforts for introducing competition in the Turkey's power industry, and concerns with the restructuring in Turkey. The paper discusses social and technical problems that the Turkey's power industry is facing during the transition from monopoly to a competitive market. Recommendations are provided in the paper for achieving some of the objectives in electricity reforms.**

***Index Terms*— Turkey, Electricity Restructuring, Market.**

I. INTRODUCTION

Turkey is moving towards a competitive electricity market with the presumption that the competition will lead to technological improvements, better services, higher efficiency, improved reliability, as well as less costly delivery of electricity to customers. Electricity reforms are underway in Turkey with the purpose of not only offering better services to consumers at lower prices but also gearing up for the European Union (EU) membership. Turkey attained its candidacy for the EU membership in 1999.

Electricity industry restructuring has received government priorities worldwide while restructuring policies are debated at all levels internationally. U.K., Canada, Chile, Argentina, Nordic Countries, Australia, and U.S. are among countries that have introduced restructuring by making significant changes to their electricity sectors. The preliminary experiences have shown that the establishment of electricity market is going to be specific to legislations, cultures, economy, and electricity operations and practices in participating nations [1]. This study discusses the electricity restructuring in Turkey considering the special geographical and economical features of the country in the 21st century.

The paper is organized as follows. Electricity power sector and restructuring efforts in Turkey are presented in the following two sections, respectively. The concerns and the suggestions for electricity restructuring are addressed in section 4. Conclusions are provided in section 5.

II. COUNTRY OVERVIEW

The Republic of Turkey is located between northwest Europe and Asia, bordering the Mediterranean, Aegean and Black Seas. The northwest of Turkey is separated from the rest of the country by Dardanelles and Bosphorus straits, and the Sea of Marmara. The neighboring countries are Greece, Bulgaria, Armenia, Azerbaijan (Nahcivan), Georgia, Iran, Iraq, and Syria. The population of the country was about 68 million in 2001 with a geographical area of 780,580 km^2. Above 50% of the population lives in urban centers, the largest of which are Istanbul (10 million), Ankara (capital, 4 million), Izmir, Adana and Bursa.

The Turkey's economy offers quite a contrast. For more than a century, there have been concerted attempts to industrialize and modernize the country with varied intensity and outcomes. As a result, modern industries coexist today with pockets of primal farming [2]. The major cities of western Turkey are cosmopolitan centers of industry, finance, and trade, whereas the eastern part of the country is relatively underdeveloped. There has been massive migration from the eastern part to the economically viable urban centers of western Turkey.

Turkey has had a strong economic growth especially between 1995 and 1998 which has faced difficulties to upkeep its paste in recent years. After years of steady growth (3.7% annually between 1991 and 2000), the economy declined in 1999 due to two severe earthquakes and deteriorated sharply in February 2001 as devastating financial crises forced the country to sharply devalue its currency, the lira. In addition, Turkey's inflation and unemployment soared, and its gross domestic product (GDP) fell sharply by 7.5% in 2001. 2001 represented an unusual paste in Turkey's economy when its annual electricity consumption declined by 1.1% due to economic crises.

Beyond economic crises of 2001, financial measures of the country returned to positive by significant policy changes and financial support from the International Monetary Fund (IMF) and the World Bank (WB). GDP growths were reported as 7.8% and 5.9% in 2002 and 2003, respectively, and the economic growth is expected to be 6% in 2004. According to figures reported by the Ministry of Energy and Natural Resources (MENR), Turkey's total electricity consumption increased by approximately 4.3% and 6.3% in 2002 and 2003, respectively [3]. Turkey's greatest challenge in the framework of a still predominantly state-owned energy sector is to meet its fast-growing energy demand while pursuing a stable budget surplus, striving to limit its foreign debt under the agreements with IMF and WB, and preparing itself for the EU membership.

III. POWER SECTOR IN TURKEY

A. Electricity Generation and Power Resources

Natural gas constitutes a crucial element of the Turkey's energy sector. The 20 billion cubic feet (bcf) of natural gas produced in Turkey in 2000 met merely a 3.8% of its domestic consumption. The rest of consumption was imported either by pipelines or as liquefied natural gas (LNG) from neighboring countries (mostly Russia). Turkey's natural gas consumption is expected to quadruple within the next 20

years [4].

Turkey is determined to make a good use of its geographic location as a transit country for linking the oil- and gas-rich Caspian Sea area to the Mediterranean and demand centers of the West. Several pipeline projects are underway to accomplish the task. Turkey is a player in the proposed Nabucco gas pipeline project (Turkey-Bulgaria-Romania-Hungary-Austria) for which the Caspian Basin countries, including Iran, could supply gas. Turkey is collaborating with the Mashreq countries in this project to supply EU with natural gas from Egypt, Syria and, when conditions permit, Iraq [5].

Turkey has coal and lignite deposits which are widespread and plentiful. Lignite deposits are estimated to be 8 billion metric tones which are ranked as the seventh largest in the world. However, only small parts of these deposits are suitable for electricity generation due to its low quality. Coal consumption for the installed generating capacity was 23.15% in 2003. There is no nuclear power plant in Turkey. In July 2000, Turkey canceled its plans for building a 1,400 MW nuclear power plant. The cancellation was caused by the Turkey's economical situation and the Turkish Treasury Department's refusal to grant a sovereign guarantee for the project. Nuclear energy is not envisaged as an alternative source in the projections until 2010.

The distribution of Turkey's installed generating capacity by the end of 2003 is given in Fig. 1. The figure indicates that the additional natural gas units are taking the place of hydroelectric and coal units. Turkey's geography -- a rectangular plateau peninsula surrounded on three sides by seas -- is highly conducive to hydroelectric power generation; Turkey has about 1% of the world's hydroelectric potential [4]. Hydroelectric power generation in Turkey accounted for 35% of its total capacity by the end of 2003. The Turkish government intends to expand its hydroelectric capacity to 35,000 MW by the year 2010.

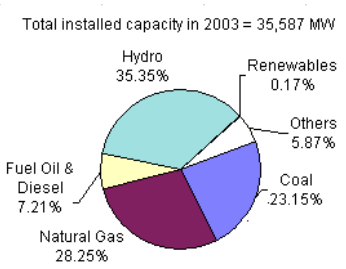

Fig. 1. Fuel share of the installed capacity (Renewables: Wind 0.05%, Geothermal 0.04%, Biomass 0.08%; Others: Coal & NG Combination 4.09%, Coal & Fuel Combination 1.31%, LPG 0.08%, Naphtha 0.38%) – TEIAS.

Turkey has a considerable potential for electricity generation from wind. A study carried out in 2002 concluded that Turkey has a theoretical wind energy potential of nearly 90,000 MWe and an economical wind energy potential of about 10,000 MWe [4]. However, the country's current share of wind power generation is almost negligible because of its relatively high investment cost. Turkey has significant potentials for geothermal power production, possessing one-eighth of the world's total geothermal power capacity. Much of this potential is of relatively low enthalpy which is not suitable for electricity production but is still useful for direct heating applications. Although there is a considerable potential for the use of solar energy, the current share of solar energy for electricity generation is almost negligible due to its high investment costs.

B. Electricity Consumption

Despite economic crises, the net electricity consumption in Turkey is doubled over the last decade. During the 1990-2000 period, electricity consumption increased by 8.6% annually [6]. In 2002, Turkey's electricity consumption increased by 4.3% to 132.6 TWh, it rose by 6.3% to 140.9 TWh in 2003, and it is expected to grow by 7.2% to 151.1 TWh in 2004. Although MENR is forecasting an electricity demand of 250 TWh-*max* for 2010, Table 1 shows that Turkey's present per capita electricity consumption is low compared with countries such as the United States.

TABLE I
ELECTRICITY CONSUMPTION PER CAPITA, KWH, 2001 (SOURCE : UNDP)

Turkey	OECD-Total	United States
1,849	8,503	13,241

Load consumption in Turkey is depicted in Fig. 2 in which half of the consumption is industrial and most of which are located on the northwest of the country. Fig. 3 shows that Turkey's peak demand occurs in winter at about 6:00 p.m. which is mostly for heating purposes.

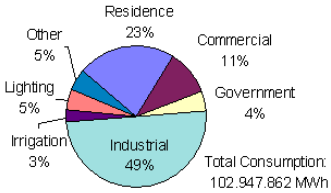

Fig. 2. Load consumption categories in 2003 (Source: TEIAS)

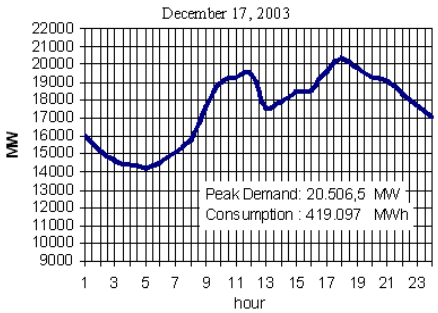

Fig. 3. Daily load curve in a typical winter day (Source: TEIAS)

The electricity price for industrial consumers is as high as that for residential consumers in Turkey. The cost of supplying residential consumers is much higher than that of supplying industry which shows a sure sign of cross-subsidies in favor of residential customers. This is confirmed by international comparisons in Figs. 4 and 5 [2]. In 2002, Turkey's industrial electricity price (9.4 cents/kWh) was the third highest among 21 OECD countries. The price of electricity for households was among the cheapest in 21

OECD countries before 2002 when it was 9.9 cents/kWh. In 2003, the price decreased to 9.1 cents/kWh. The higher price in relative terms to industrial use lead to complaints by industries that their competitiveness is thereby restricted. The fact that the cost of supplying electricity remains to be so high indeed constitutes an impediment to regional and international competitiveness [3].

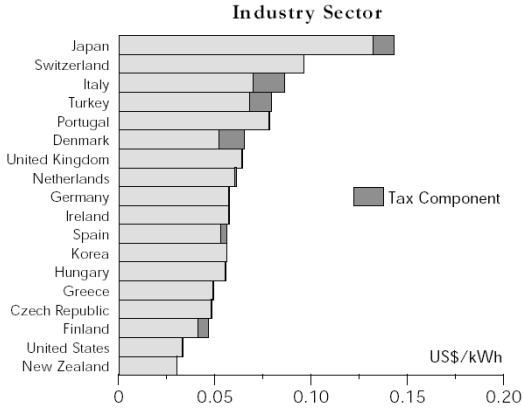

Fig. 4. Industry sector electricity prices in IEA countries (1999)

The high cost of energy in Turkey is attributed to several significant factors including long-term high cost take-or-pay contracts (discussed later), lack of competition, technical and non-technical (theft) losses, delays and insufficiencies in rehabilitation for existing generating units and investment for new state owned plants, high cost of natural gas, and insufficient planning and technological development.

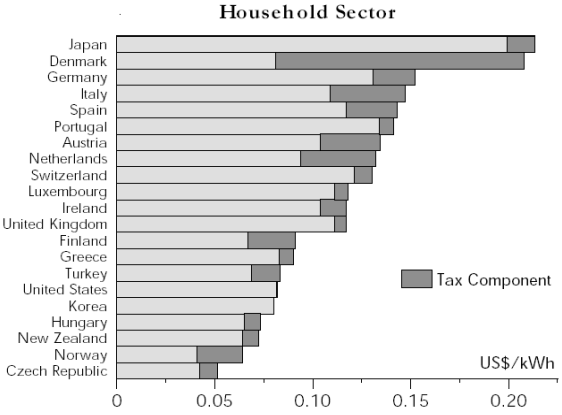

Fig. 5. Household sector electricity prices in IEA countries.

C. Supply-Demand Balance

Total installed generating capacity in Turkey was approximately 36 GW in 2003. Fig. 6 depicts the forecasted peak demand and installed capacity. It is clear form this figure that there is a need for rapid build-up of new generating capacity to supply the growing demand, which may be in the order of 3 GW per year for upcoming years. The government has estimated that the capacity expansion would require an additional investment of $3.5 to $5 billion per year [2].

D. Electricity Grid and Interconnection

The main demand centers in Turkey lie in western and northwestern parts of the country, whereas a sizeable installed generating capacity is in the east and southeast. Therefore, transmission was mainly designed to handle large power flows along a diagonal path across the country. Fig. 7 shows that the transmission system consists of 400 kV and 154 kV transmission grids. The total length of transmission lines was about 46,000 km by the end of 2003.

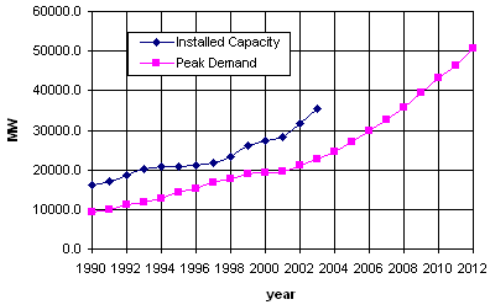

Fig. 6. Installed Capacity and Peak Demand (Source: TEIAS)

The long transmission distances between load centers and electricity generation areas cause substantial line losses. The 3% transmission line loss is higher than those in most other IEA countries. However, the distribution loss of about 20% is significantly higher than that of many other IEA countries. Theft constitutes the majority of reported losses.

Turkey is a net importer of electricity. Turkey's main supplier of electricity is Bulgaria, which provided 3500 million kWh (3.5% of turkey's total consumption) in 2002. There are few transmission links with neighboring countries; however, Turkey's power system is not synchronized with the interconnection in neighboring countries. Hence, power imports and small amounts of exports are carried out via island operations. This means that Turkey's importing regional grids are synchronized with that of the exporting country, but isolated from the rest of the Turkish grid. As an island mode of operation is cumbersome and inefficient, Turkey is striving for synchronization with neighboring countries and is cooperating with various international forums to establish large and regional interconnected systems. These new interconnections include the "five-country" interconnection (Egypt, Iraq, Jordan, Syria, and Turkey), and the Mediterranean ring, all of which are under study. One of the new projects in which Turkish authorities are very keen to achieve progress is the link to EU electricity network, i.e., Union of Coordination of Transmission of Electricity (UCTE). Turkey eventually plans to interconnect its system with the UCTE grid via Greek and Bulgarian grid.

IV. RESTRUCTURING IN TURKEY

A. History

The construction and operation of power plants in Turkey started in 1950's by both state utilities and private sector entities. Growing generation and consumption of electricity as well as the necessity for expanding the respective services made it essential to form an institutional structure and thus Turkish Electricity Authority (TEK) was established in 1970.

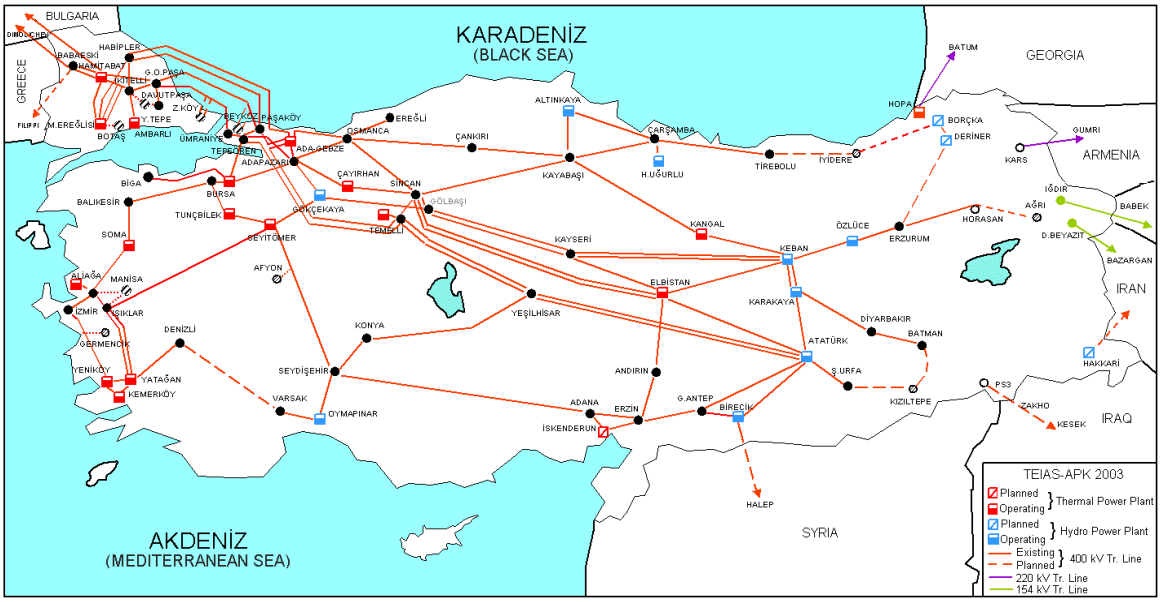

Fig. 7. Map of the Electric Power Network of Turkey (Source: TEIAS)

Following the reform program and the opening of the Turkish economy in 1983, TEK's statutory monopoly was abolished by the 1984 Electricity Act, and it became possible for private companies to engage in power generation, transmission and distribution under the Build-Operate-Transfer (BOT) system. Turkey was among the first countries to introduce the BOT system through the Electricity Act. TEK was reorganized in 1993 into two State-Owned Enterprises: Turkish Electricity Generation Transmission Co (TEAS) and Turkish Electricity Distribution Co (TEDAS) by the Act of the Council of Ministers.

There have been several approaches employed over the last two decades to restructure the power sector and solicit private investments. Four different models were used for restructuring to attract private investors, including BOT, Build-Own-Operate (BOO), auto-producer, and the Transfer of Operating Rights (TOOR). The first three models are used to obtain private investments for new power plants. The TOOR model is used to liquidate existing generating assets and distribution companies to private investors. BOT and BOO approaches attracted substantial new power plant investments. The auto-producer model, which is essentially a form of self-generation employed by industries that sell their surplus energy to TEAS, has created large sums of capacity without any associated public liabilities (Fig. 8).

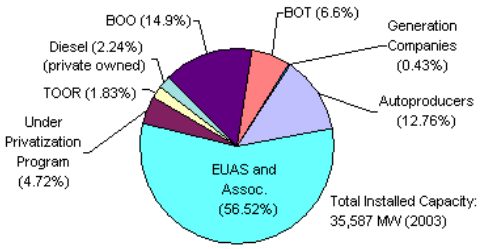

Fig. 8. Distribution of installed capacity (Source: TEIAS)

B. *Electricity Market*

In response to the need for sustainable private involvement in the electricity sector, the government has embarked on a far-reaching reform program that aims at establishing a competitive market structure with separate generation and distribution firms that could gradually be privatized. These reforms are progressing in accordance with the principles and time frame defined in the Electricity Market Law which was enacted in February, 2001. The Law covers generation, transmission, distribution, wholesale, retail and respective services of electricity including its import-export and the rights and responsibilities of individuals connected with those services, establishment of a Regulatory Body and its running procedures and principals, as well as actions to be followed for the privatization of generation and distribution assets [7].

In response, TEAS was restructured to form three State-owned Public Enterprise, i.e., Turkish Electricity Transmission Co. (TEIAS), Electricity Generation Co. (EUAS) and Turkish Electricity Trading and Contracting Co. (TETAS). A new regulatory board, Energy Market Regulatory Authority (EPDK, in native initials), was set up to oversee the Turkish power market, regulate tariffs, issue licenses, and prevent uncompetitive practices. TEDAS continues to be in charge of distribution with its seven regional affiliate companies.

Following the completion of the necessary sector reforms and the restructuring of state-owned electricity enterprises, the electricity generation and distribution system operation rights will be privatized within a schedule declared by the government. A strategy document entitled "Electricity Sector Reform and Privatization Strategy" was prepared and was approved and issued by the High Planning Council in March 2004. This document, which outlines the electricity policies for forthcoming years, represents the most significant steps concerning energy policy since the enactment of the law [8].

C. Stages of Restructuring

According to the privatization strategy, the privatization of power plants will start after the privatization of power distribution system is substantially completed, and the market management system is established and functioning with hourly prices expected in mid-2006. A transitional balancing and settlement mechanism will be in place before the privatization of generation assets which is envisaged to start in 2006. In light of developments for securing a sufficient generating supply, the market will gradually open in order to reach its 100% capacity by 2011.

V. CONCERNS LINKED TO RESTRUCTURING

The electric generation and distribution industry in Turkey is in a transitional stage from the former public sector dominated market to a liberalized market. Main concerns linked to restructuring at this period are as follows.

A. Promotion of Generating Capacity

Although excess generating capacity exists at this time, the future development of supply has to be ensured. If the proposed reforms are implemented properly through legislation and subsequent actions, market price discovery could generate investment signals that stimulate new capacity. Accordingly, financially viable potential market participants could respond to the emergence of supply shortages.

In addition to promoting the investment in generating capacity, attempts should be made on the consumption side for increasing the time-of-the-day metering which has not become widespread yet. Energy pricing is a very important tool for demand side management, especially in the long run. Incentives should be established for maintaining a larger load factor and for conservation during peak hours and seasons.

B. Privatization

Without a considerable participation of private sector, the electricity market restructuring in Turkey will be a failure. This is due to the fact that the power sector would require capital investments to refurbish and expand the old and inefficient generating, transmission, and distribution facilities. The foreign investment could be attracted to a reliable, non-bureaucratic, and efficient access to the electricity market.

It is stated in the Strategy Document that distribution companies, holding retail licenses, and operating opportunities in an electricity market, have to create investors' confidence in the privatization of distribution system [8]. However, some believe that initiating the privatization with the distribution system is an imprecise strategy because potential private investors in generation assets would be kept at bay for a longer period. Conceivably, state enterprises and institutions could retain their dominant power for an unnecessary additional period and inefficiencies could continue to expect the least [3].

C. Long-term Contracts

1990s was a period when Turkey's public finances generally performed poorly which resulted in increasing deficits and public debts and an overall deterioration of fiscal infrastructure. At the same time, relatively large new investments in the energy sector appeared to be essential. Large energy investments by the private sector were not on the agenda and the public sector's economic difficulties did not allow sufficient financing for the needed energy investments. Therefore, a shortage of energy was alarmed and this fear was heightened commencing in the mid1990s. A number of BO and BOT contracts corresponding to the overestimated electricity demand were signed in a rush and began to be implemented before crises. These commitments made it difficult to establish a market in a shorter timeframe and largely based on competitive forces. The guaranteed costs of disputed contracts must be adjusted by Turkey's current legal framework and the established timetable for phasing out the existing subsidies should be enforced as suggested in [5]. Delay in the resolution of this problem could discourage potential investors from investing in the sector.

D. Liberalization of Electricity Prices

Electricity prices are currently regulated for the captive customers, which will supposedly be set by the electricity market in the future. At the present time, there is a subsidy on residential electricity prices. To soften the public outcry for relaxing the subsidies after establishing the electricity market, all organizations involved in the electricity power sector should be involved in more aggressive public relations campaigns [12]. Especially the government and electricity authorities should do much more in explaining the core of the reform and its long-term consequences and benefits. It should be taken into account that certain population sectors in Turkey with a relatively low income may not be able to bear any substantial increases in their cost of living. Therefore, it is essential to introduce incremental steps for initial increases in energy prices before competitions among suppliers could stabilize market prices.

E. Energy Quality and Security

Parallel to liberalization, the Turkish Government plans privatization of lignite-fired thermal power plants, most of which require upgrading. Rehabilitation and improvement work in general have been lagging behind in the poor result of the economic crisis. In addition, most of the investments at state-owned power plants were frozen and postponed due to privatization process. On the other hand, Turkey wishes to interconnect its power system with the UCTE grid and preliminary studies are still going on to satisfy the UCTE regulations. However, this project was delayed due to much needed improvements in Turkey's electricity grid. For instance, larger power plants in Turkey would need to be refurbished to satisfy the UCTE requirement for frequency control [10]. The problems increase as the privatization delays resulting in poor quality and security of the electricity.

F. Technical and Non-technical Losses

TEDAS, which is responsible for the daily operation of

distribution system, owns and operates over 650,000 km of medium and low voltage distribution lines. Technical and theft losses in regional distribution grids vary between 10-30 percent. Although some of the reported measures are technical, theft losses represent the majority of losses which occur mostly in southeastern, eastern, and Thrace. The total loss in distribution system remains to be around 22% of the generated electricity valued at 1.7 billion euro in 2002 [11]. Technical losses can be managed better by applying new investment to augmenting distribution lines and transformers.

G. Increase in the Reliance on Natural Gas

Since Turkey's own natural gas production is very limited, the additional demand is met by imports as stated above. Significant reliance on the natural gas supply could seriously affect the security and the market price of electricity. Energy companies and government agencies must consider an integrated approach to the operation and planning of natural gas and electricity infrastructures to assure that the pertinent economical and critical security issues are dealt with for the near future.

On the other hand, electricity markets around the world will need to create synergies between different markets like electricity and gas in order to profit from the arbitrage of various commodities [9]. Strategies should be devised for gas and oil and regulatory framework should be strengthened as Turkey strives to make good use of its geographic location as a transit country linking the Caspian sea countries to the Mediterranean and the West.

H. Environmental Issues and Renewables

One of the subject areas that require much improvement in terms of socio-economic-environmental concerns in Turkey is the operation of older coal thermal plants. Turkey has not yet ratified the Kyoto Protocol. However, Turkey needs to continue integrating environmental protection requirements into the definition and implementation of all other policies so as to promote sustainable development of its energy policy. A new law was drafted in 2004 for issuing effective incentives for promoting the investment in and utilization of renewable energy sources. The proposed studies should not be delayed and an overall renewable energy strategy has to be put forward in Turkey to achieve increased use of renewable energy sources as a means of managing environmental issues, reducing the reliance on foreign fossil fuel purchases, and deferring the planned and retrofitting of the existing transmission and distribution system.

I. Need for Qualified Staff and Expertise

There is a tendency in developing countries, as in Turkey, to adopt the structures implemented in the pioneering Western countries without a critical appraisal of their suitability in the local context [13]. However, critical appraisal requires qualified staff and expertise which is another problem in developing countries. The actual reforms are implemented not by laws and directives, but by people. With the increasing number of market players, increasing number of transactions taking place, and withholding the information by competitors, daily operations and the planning of future markets will become more difficult. New institutional mechanisms require much new technology and much research than before. In this respect, the shortage of qualified staff that would be capable of fast and reliable implementation of reforms can be a significant obstacle for restructuring [14].

VI. CONCLUSIONS

This paper presents a brief analysis of the existing electric power sector and its restructuring in Turkey. The concerns linked to restructuring can be divided into social, economical, and technical issues, most of which are very similar to the exiting concerns in other developing countries. Some of these concerns include cross-subsidies in household tariffs, high technical and non-technical losses, requirement for capital investments to refurbish and expand the old and inefficient generation, transmission and distribution facilities, environmental protection requirements of older coal power plants, etc. On the other hand, main concerns specific to Turkey include long-term high cost agreements, low quality of power and therefore restrictions for synchronization with UCTE network, increase in the reliance on imported natural gas, and the urgent need for highly qualified staff that would be capable of fast and reliable implementation of ongoing reforms in the electricity sector.

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VIII. BIOGRAPHIES

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