



Electricity industry restructuring in Iran



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ABSTRACT

Iran, as a developing country with a growing population, has an increasing energy consumption. In particular, the electricity consumption with the average annual growth rate of 7.24% has been increasing considerably over the past two decades.

In step with the changes in the world electricity industry, initial steps towards restructuring in Iran's electricity industry were taken during the 1990s, resulting in the launching of Iranian wholesale electricity market in November 2003. Achieving long-term security of supply, clarification of the electricity price and the attraction of the private investments are some of the main goals of the electricity industry restructuring in Iran. The privatization and breaking of the governmental monopoly was officially started in 2000 with the beginning of the third development plan, which led to the 48.05% contribution of the private sector in the annual energy generation in 2015.

This paper investigates the process of restructuring in Iranian electricity industry comprehensively. The current situation and the history of Iran's electricity industry, as well as the operating principles of Iran's electricity market and its prominent characteristics including its regulations, entities and administrative process, are discussed in this paper. Moreover, some of the results including privatization process and the changes in the electricity price are investigated in this paper.

1. Introduction

Over the past two decades, electricity industry has gone through restructuring in many countries around the world. In this regard the governments' attitudes toward ownership, management, operation, and planning of power systems have changed dramatically in recent years and improving the economic efficiency has been claimed as the main goal in these domains. This process has brought on the separation of sectors with different tasks, raising competition at wholesale and retail markets alike. The study and analysis of different countries restructuring process, as practical patterns, can be helpful for decision-makers in this area. Therefore this area of study has gained a large attention as (Danias et al., 2013; Mustafa Durakoğlu, 2011; Du et al., 2009; Ngan, 2010; Knaut et al., 2016; Nelson and Orton, 2016; Nepal and Foster, 2015). In (Danias et al., 2013) the evolution of the Greek

electricity market since the beginning of the liberalization process is investigated. In addition, the remaining key deficiencies in the policies, which need to be resolved, are discussed in (Danias et al., 2013). In (Mustafa Durakoğlu, 2011) the political and economic endowments of the electricity market in Turkey are analyzed. The impact of the regulatory reforms on electricity generation plants in China is estimated in (Du et al., 2009). Moreover, the main three stages of the reform in the electricity industry of China until 2011 (e.g. electricity energy investment financing, the separation between government and power enterprises, and the division between the power grids and the power generation firms) are reviewed in (Ngan, 2010). An overview of the energy legislations passed in 2010 by the German government and the German Energy Reference Forecast and in accordance with the investment and dispatch model for the European electricity sector over the planning horizon up to 2050, is presented in (Knaut et al., 2016).

Abbreviations: AEP, Average Electricity Price; AHEP, Average Hourly Electricity Price; ASP, Ancillary Services Procurement; AVC, Average Variable Cost; BAP, Base Availability Price; BOO, Build-Operate-Own; BOT, Build-Operate-Transfer; CHP, Combined Heat and Power; DAM, Day Ahead Market; DG, Distributed Generation; DISCO, Distribution Company; ECA, Energy Conversion Agreement; EC, Electricity Cost; FERC, Federal Energy Regulatory Commission; GENCO, Generation Company; HEP, Hourly Energy Price; IEE, Iranian Energy Exchange; IEM, Iranian Electricity Market; IEMRB, Iran Electricity Market Regulatory Board; IGMC, Iran Grid Management Company; IGOMC, Iran Grid Operation & Monitoring Center; IOEP, Iran Organization for Electric Power Affairs; IPP, Independent Power Producer; ISO, Independent System Operator; MCP, Market Clearing Price; MO, Market Operator; MOE, Ministry of Energy; OR, Operational Reserve; PAB, Pay-as-Bid; PBM, Pool-Based Market; PCMEI, Privatization Council in Ministry of Energy of Iran; PFC, Primary Frequency Control; PGMC, Power Generation Management Company; PPA, Power Purchase Agreement; REC, Regional Electric Company; WAP, Weighted Average Price

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The dynamics of the electricity market in South Australian is studied in (Nelson and Orton, 2016). Based on the results presented in (Nelson and Orton, 2016) a review of the energy market frameworks is suggested due to failure to achieve the decarbonization-related objectives in the existing market. In (Nepal and Foster, 2015) the economic performance of the private and state-owned electricity networks in Australia is modeled and compared in term of prices, quality and investment. The study results show the superior performance of the privately owned networks in comparison with the state-owned networks.

Iran, as a developing country, has adapted to the changes in the world electricity industry. Some initial steps towards restructuring were taken during the 1990s which eventually resulted in the launching of Iranian wholesale electricity market in November 2003. Achieving long-term security of supply, clarification of the electricity price and absorption of private investment as well as business growth are the main goals of electricity industry restructuring in Iran (Karim and Reza, 2009).

Iran is a middle-eastern country with the total area of 1648195 square kilometers. According to the 2011 census, Iran has a population of around 75 million people. To the north, it neighbors Azerbaijan Republic, Armenia, and Turkmenistan, to the east, Afghanistan, and Pakistan and to the west, Turkey and Iraq. Iran borders the Caspian Sea to the north and the Persian Gulf and Oman Sea to the south (Wikipedia, 2015; Statistical center of Iran, 2015).

Iranian electricity industry started its activity in 1903 when a few generators were imported into Iran. The electricity industry in Iran has undergone several changes in early years; one of which was the result of the implementation of five development plans from 1936 to 1977 that resulted in the improvement of indices such as installed capacity, reduction of costs, development of grid and public electrification (Bankian Mohammad, 2007).

In the course of the war with Iraq, from 1980 to 1988, and the years that followed, electricity industry focused on reconstruction the damages of the war. The development of electricity industry was restarted and speeded up by implementation of five new social, cultural and economic development plans since 1989 (Bankian Mohammad, 2004). Iran's Ministry of Energy (MOE) began restructuring the electricity industry in the early 1990s. The purpose was to secure electricity supply, attract investment from private sector and accelerate the business growth in Iran's electricity industry. Gradually, different parts of electricity industry went through different changes (e.g., unbundling the vertically integrated utilities, privatization, and the introduction of Energy Conversion Agreements (ECA) to buy electricity produced by Independent Power Producers (IPPs)). This resulted in the launching of Iranian (wholesale) Electricity Market (IEM) as one of the foundations of the restructuring. Shortly after, Iran Grid Management Company (IGMC) was established in November 2004 as the main entity in electricity market operation. At the same time, Iran Electricity Market Regulatory Board (IEMRB) was founded to fulfill its role as the main legislative body of IEM (Heidary, 2003). Along with restructuring, the private sector started to provide limited services (e.g. power plant operation and maintenance), and in the late 1990s, the private sectors were allowed to participate in the ownership of power plants' assets.

This paper presents an overview of the Iranian electricity industry, the structure of IEM, and some of its important aspects such as generation and consumption characteristics, geographical spread, and the changes that have happened during the restructuring of the industry. General specifications of Iran electricity grid such as the price of electricity consumption for different categories of consumers (residential, public, industrial, agricultural, and commercial consumers), and the rate of load growth and foreign imports and exports are discussed in this paper. The history of the restructuring of Iranian electricity industry, the rules and entities established, and the progress made in privatization are discussed in more detail. Also, the operation

and clearing process of IEM and the procurement of ancillary and transmission services are discussed. Finally, to study the economical indices of Iranian electricity industry, wholesale and retail prices in the past six years are analyzed.

This paper is organized as follows: In Section 2, the current situation of the electricity industry in Iran is briefly discussed. The history of the Iranian electricity industry development, as well as important events in a chronological order, are given in Section 3. The administrative process of the electricity market in Iran is discussed in Section 4. In Section 5, energy prices in the last eight years are analyzed. Finally, the plans implemented to improve the IEM as well as the required plans for future are discussed in Section 6. The paper is concluded in Section 7. Appendix A summarizes the process of privatization of Iranian electricity industry and in Appendix B, rules and entities established for this purpose are reviewed. Timing, fiscal logic, and clearing process in energy and reserve market are also addressed in Appendix C and D. Ancillary services and their procurement methods are dealt with in Appendix E. We further elaborate on Iranian Electricity Exchange (IEE) and the way it is operated in Appendix F.

2. Electricity industry in Iran

2.1. The structure of ownership and regulation

The main agent in Iranian electricity industry is the MOE. In the electricity sector, towards sustainable development, the mission of the MOE is to ensure and promote the security of electricity supply and to ensure and promote the quality of services. MOE is in charge of making strategic energy policies to execute its missions. Iran Power Transmission, Generation and Distribution Company (Tavanir), is responsible for generation and transmission expansions and wholesaling the electricity all over the country. Tavanir, as a governmental company, is supervised by the MOE and is considered to be the executive branch of the MOE. Tavanir puts all the decisions made regarding the use and development of electricity industry into practice. This organization also helps the MOE in plan-making and supervision tasks (Heidary, 2003).

Presently (2016) the main active companies in Iran's electricity industry can be classified as: 16 Regional Electric Companies (RECs), 39 Power Generation Management Companies (PGMCs), 39 Distribution Companies (DISCOs), some Generation Companies (GENCOs), and some other active companies including IGMC, that are under supervision of MOE and IEMRB (Heidary, 2003; Management of information technology and statics office of Tavanir, 2015a). RECs have a managing role in their geographical area. They also monitor subordinate companies and are responsible for transmission, and selling of electricity in the transmission level. Each REC owns the governmental power plants in its region so they also have a GENCO's role too. In every region, RECs are in possession of transmission equipment. Based on articles of the establishment of RECs, Tavanir holds all of the shares of these companies. Fig. 1 shows the locations of RECs and cross-border exchanges of electricity (FTP site of regional electricity companies, 2010).

Each DISCO is responsible for the development, maintenance, and operation of the distribution grid, as well as ensuring the quality of provided electricity in its geographical area (province or city). Presently, 40% of shares of each DISCO belongs to Tavanir and the remaining 60% is controlled by SABA Company. SABA Company was established in 2004, with both public and private shares, for the purpose of constructing and operating non-governmental power plants. With the purpose of restructuring the electricity industry, Iranian parliament passed a law enforcing the independency of DISCOs. As a result, as of 2005, these companies are no longer subdivisions of RECs and act independently.

PGMCs, founded as non-governmental companies (with joint

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