

Nuclear power in open energy markets: A case study of Turkey[☆]

Erkan Erdogdu*

Energy Market Regulatory Authority, Ziyabey Cad. No:19 06520 Balgat/Ankara, Turkey

Received 28 August 2006; accepted 10 November 2006

Available online 19 December 2006

Abstract

For many decades, like many developed countries, Turkey has controlled her electricity sector as a state-owned monopoly. However, faced with rapid electricity demand growth, Turkey started to consider nuclear option. The present paper aims at evaluating both the present status of nuclear power in general and its implications for Turkish energy market in particular. After examining existing nuclear power technology and providing a brief overview of nuclear power economics; it focuses on the repercussions of nuclear power for Turkish energy market. The paper concludes that, in the short run, it may be considered to keep nuclear power within Turkish energy mix because it is an important carbon-free source of power that can potentially make a significant contribution to both Turkey's future electricity supply and efforts to strengthen Turkey's security of supply. However, in the long term, nuclear power should be retained in Turkey only if it has a lower cost than competing technologies.

© 2006 Elsevier Ltd. All rights reserved.

Keywords: Turkish energy market; Nuclear power; Electricity

1. Introduction

The Republic of Turkey (hereafter Turkey) is located between Europe¹ and Asia, bordering the Mediterranean, Aegean and Black Seas. Turkish economy, the world's 16th largest economy, is a dynamic and emerging one (Ozturk et al., 2005). In 2004, Gross National Product (GNP) was realized as 269 billion USD, which corresponds to 3750 USD per capita. In 2004, annual GDP growth rate was 8.9%. Population of Turkey is about 71.7 million and the population growth rate is 1.4% (World Bank, 2006). The

economy has undergone a significant shift away from agriculture towards the industrial and especially the services sector in the last three decades, although 29% of the active population is still employed in agriculture (Turkstat, 2006). The net effect of all these factors is that Turkey's energy demand has grown rapidly almost every year and is expected to continue growing.

With an average final electricity consumption growth rate of 8.3% per annum over the 1973–2002 period, Turkey is among the fastest growing energy markets in the world² (IEA, 2004, p. II.624). The government expects demand growth to accelerate in the coming decades with an average annual growth rate between 6.3% and 8.4% (see Table 1).³

In short, it is obvious that electricity consumption in Turkey is growing very rapidly. To cope with the expected increase in electricity consumption, there exist some options, among which one of the most controversial is nuclear.

[☆]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" by the Department of Economics, University of Surrey (UK). 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.

*Corresponding author. Tel.: +90 312 2872560; fax: +90 312 2878819.

E-mail address: erkan@erdogdu.net.

URL: <http://erkan.erdogdu.net/>.

¹In October 2005, accession negotiations are opened with Turkey, who has been an associate member of the EU since 1963 and an official candidate since 1999. For a more detailed discussion of EU–Turkey relations, see Erdogdu (2002).

²During the same period, on average, final electricity consumption increased by only 2.9% annually in OECD countries, which corresponds to about 1/3 of the figure for Turkey (IEA, 2004, p. 1.46).

³However, official projections highly overestimate the electricity demand in Turkey. For more information on Turkish electricity demand, see Erdogdu (2006b).

Table 1
Official gross electricity demand forecast: 2006–2015

Years	Scenario 1		Scenario 2	
	GWh	Growth (%)	GWh	Growth (%)
2006	171,430	—	171,430	—
2007	185,830	8.4	182,230	6.3
2008	201,440	8.4	193,711	6.3
2009	218,361	8.4	205,914	6.3
2010	236,703	8.4	218,887	6.3
2011	256,586	8.4	232,677	6.3
2012	278,139	8.4	247,335	6.3
2013	301,503	8.4	262,918	6.3
2014	326,829	8.4	279,481	6.3
2015	354,283	8.4	297,089	6.3

Source: TEIAS (2006a).

Stimulated by the urgency of the Second World War, nuclear science progressed rapidly from the discovery of the neutron by Sir James Chadwick in 1932. The first controlled chain reaction took place in 1943, the first atomic weapon was developed in 1945, and in 1951 electricity is produced using nuclear energy for the first time. Following its first application for generating electricity in the USA, nuclear energy began to be applied to the production of electricity in the UK (1953), Russia (1954), France (1956), and Germany (1961); that is, five countries within the first decade. Ten more countries began nuclear-based generation in the 1960s followed by another ten in the 1970s. The oil crisis of the early 1970s provoked a surge in nuclear power plant (NPP) orders and construction. Later that decade, the world economic slowdown combined with the declining price of fossil fuels curtailed the growth of nuclear energy demand. As this took effect, two accidents, at Three Mile Island in the USA (1979) and at Chernobyl in the former Soviet Union (1986), raised serious questions in the public mind about nuclear safety. The overall effect was a significant slowing of nuclear energy's growth in the 1990s. Nevertheless, some countries continued to push ahead strongly with reactor construction, thus contributing to small increases in nuclear electricity production (OECD, 2003). Today, there are 441 nuclear reactors in operation worldwide, with an additional 35 under construction. Nuclear power provides about 17% of the world's electricity (Duffy, 2004). To put it shortly, the 50-year history of commercial nuclear power has been punctuated by dramatic policy changes. The first 20 years, marked by limited public participation, tight government control, and promises of clean, abundant energy, were followed by a period of intense social and political conflict over the technology's environmental and safety implications. Nuclear policy in the USA and most European nations shifted from all-out support to a more ambivalent posture, which led to a dramatic slowdown in the construction of new plants.

For many decades, like many developed countries, Turkey has controlled her electricity sector as a state-owned monopoly. However, faced with rapid electricity demand growth, Turkey started to consider nuclear option.⁴ The present paper aims at evaluating both the present status of nuclear power in general (including existing nuclear technology, nuclear power economics and current status of nuclear power in the world) and its implications for Turkish energy market in particular. Section 2 provides a brief overview of nuclear power economics. Section 3 not only sets out the development and current context of nuclear power in the world but also focuses on its repercussions for the open energy markets. Section 4 considers both the historical background and current status of nuclear power in Turkey. Energy policy-makers and others whose main interest is in nuclear-related policy matters may wish to concentrate on the final part.

2. Economics of nuclear power

2.1. Costs of nuclear power

Fig. 1 shows the life cycle revenues and costs for a typical NPP. It demonstrates the factors that characterize the economics of nuclear energy, that is

- high capital investment costs;
- long planning horizons⁵ and operational life;
- low fuel, operating and maintenance (O&M) costs;
- significant costs incurred after cessation of power generation (notably management and disposal of radioactive waste and decommissioning).

Nuclear power's cost structure makes it well suited for base load power generation,⁶ since it has a high fraction of fixed capital costs and a low fraction of variable operating costs⁷.

2.1.1. Operating costs of nuclear power

Operating costs of nuclear power has two main components: O&M costs and fuel costs.

⁴Actually, in the first place, Turkey has initiated a comprehensive energy market liberalization process to cope with rapid energy demand growth. For more information on Turkish energy market reform process, see Erdogdu (2006a).

⁵Although the construction times of nuclear power plants have been sometimes rather long in the past, many recent nuclear power plants were constructed and put into service within no more than 4 years.

⁶That is, nuclear power plants should be operated at almost full capacity whenever they operate.

⁷A base load power plant is one that is operated continuously. The fixed costs per kWh energy produced declines rapidly as time passes in such a plant. Even, in the long run, they disappear as the plant pays itself back. Also, in this kind of plants, operating costs needs to be low; otherwise, the total cost of production increases enormously as it operates constantly. So, from the perspective of commercial economics, a power plant is well suited for base load power generation if it has a high fraction of fixed construction costs and a low fraction of variable operating costs.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات