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Captive power generation in Saudi Arabia—Overview and recommendations on policies

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HIGHLIGHTS

- Database of captive power generation in the Kingdom of Saudi Arabia.
- Historical perspective of electrical power industry in the Kingdom.
- Saudi Arabia's power requirements.
- Regulatory framework and key guidelines regarding captive power generation.
- It is first of its kind study in the region.

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ABSTRACT

The power sector in the Kingdom of Saudi Arabia is undergoing the restructuring process. Moreover, during the last decade the Kingdom has witnessed a phenomenal growth in the load demand, consequently a huge amount of generation is added to the electric utilities to meet the load. Up to now only the electric utility generation was taken in the planning of the electrical sector. The data regarding the captive power generation was not readily available. A survey is conducted regarding the captive power generation in Saudi Arabia based on its utilization pattern, fuel used and amount of excess energy available to the grid. The existing regulatory framework and institutional structure of the Saudi power industry was also reviewed. Based on the information collected in the survey of captive power, key guidelines that may be considered in developing the policy for the captive power generators are presented. Furthermore, these guidelines and later the policies will help promote the investors to come forward in developing the captive power generation in Saudi Arabia.

1. Introduction

Tremendously growing power demands as a result of sophisticated and materialistic life styles have put the utilities on odds. The utilities are not able to cope with the increasing power demands and also technically it is not possible to erect and operate power plants at the same pace as that of changing power demands. Under such situations, the captive power comes in to picture. Captive Power Plants (CPP's) are defined as the power plant set up or proposed to be set up by an industry, institution, a person, or a group of persons to meet their own power requirements (Web-Link1, 2012). It is expected that there would be increase in private generation companies and captive plants. Quantum of such plants is likely to grow in the coming decade (Web-Link1, 2012).

In India, captive generation plays an important role in mitigating outage costs due to persistent power shortages, (Ramesh et al., 1990). Non-utility generating capacity has remained at about 10–12% of the utility capacity in India since 1970–1971. However, the average annual utilization rate of captive capacity has declined from about 3.45 MW h/kW in 1970–1971 to 2.4 MW h/kW in 1985–1986.

According to Srivastava (1997), India has approximately 11,000 MW of captive power generating capacity, a substantial portion of which uses hydrocarbon sources including naphtha as the fuel. Under the new guidelines of the Government of India, power in excess of 50% of the capacity can be sold to the grid. The problem however is in tariff fixation because utilities are reluctant to pay tariffs at their alternative cost of new power generation. It is necessary to give captive power plants access to the grid for the wheeling of surplus power to third parties at reasonable wheeling charges. Experts recommend strong

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encouragement to captive power generation as capacities get added fast for a vital portion of the economy (Srivastava, 1997).

It has been observed that captive power plants installed in many industries in India are operating individually and are under-utilized (Baji, 1998). Maximum utilization of these plants along with the economical consideration is possible by wheeling the power between the utilities. A large number of industries are increasingly relying on captive generation because of increasing power shortages and poor quality of grid supply. For instance, nearly 10,000 MW of captive power was installed in industries during 1992/1993 (Bose and Shukla, 1999).

Thakur et al. (2005) analyzed impacts of the major policy reforms unveiled by the Government of India for revamping the country′s power sector in year 2002. These reforms are comprised of the structural changes in the power industry as well as the policy issues related to generation, transmission and distribution of power. The other major issues where transformation is sought and impacts are expected include power trading, role of regulator in the new regime, issue of open access, empowerment of the consumers and the environmental issues. The electricity prices rose in the industrial sector that bore the brunt of the subsidies provided to the domestic and agriculture sectors and by 1999–2000 the tariffs for the industrial sector became 15 times that in the agriculture sector and 2.1 times that in the domestic segment, forcing the industry to set up its own captive power plants.

According to Yang et al. (2009), in cement plant, about 90% of total energy is used as heat energy in the clinker calcination process. Out of total heat consumed in the clinker calcination process, more than 35% of heat is discharged as waste heat to the surroundings without utilization. Yang et al. (2009) proposed to effectively utilize low temperature waste heat of the exit gases from Suspension Preheater (SP) and Air Quenching Chamber (AQC) by installing a waste heat recovery (WHR) captive power plant. The study found that the expected annual power generation is 58,500 MW h. The project is expected to displace an equivalent amount of annual power currently drawn from the grid, leading to emission reductions of approximately 52,878 t CO_2 equivalent annually.

Based on the earlier studies and experiences of the international utilities as well as the local utility there is a need to look at the current status of the captive power generation in the Kingdom of Saudi Arabia and the role it can play in the electric power sector. Moreover, there is a need to look at the regulatory framework and policies of the electrical power industries in relation to the captive power generation in the country.

In view of the capital-intensive nature of the electric power sector, building and financing of new generation capacity imply substantial capital investment outlays. Therefore, in order to have optimal investment in the electric sector, one of the options is to effectively utilize all the generation available in the country to adequately meet the demand of electricity. In this respect, leveraging the captive power capacity can contribute to the optimal utilization of available resources besides rationalizing the investment in the electric sector. For leveraging the captive power and its promotion, it would be imperative to develop a sound policy which should contribute to the economic and financial sustainability of the electric power sector, and enhance the power sector efficiency and performance.

2. Power demand scenario of Saudi Arabia

In Saudi Arabia, the per capita energy consumption has reached to 20 kW h/day in 2008 compared to 19.4 kW h/day in 2007 i.e. a net increase of 3.1% in one year (Annual Report MOWE, 2008) as shown in Fig. 1. A maximum of 10% increase in per capita energy was observed in year 2004 compared to that in 2003. On an average over 25 years period from 1984 to 2008, 4.1% annual increase in per capita energy per day has been observed (Annual Report MOWE, 2008) which is really significant and needs to be addressed immediately.

Fig. 2 shows the installed generation capacity in the Kingdom during the period 2004–2011. The total installed capacity in year 2004 was 30,526 MW which increased to 32,301 MW in 2005, an increase of 5.8%. In the year 2009 and 2010, the capacity growth was 13.4% and 10.5%, respectively. The overall increase in the generation capacity during the period 2004–2011 was 67.6%. The load growth during the years 2004–2011 is presented in Fig. 3.

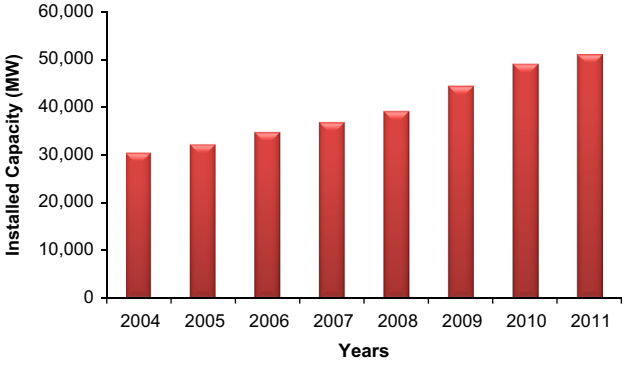

Fig. 2. Annual installed generating capacity (MW) for Saudi Arabia.

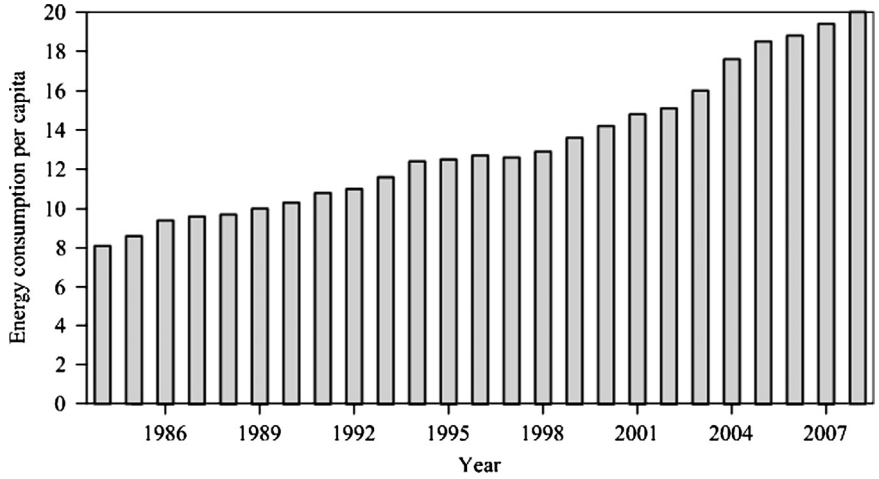

Fig. 1. Trend of per capita energy (kW h/day) consumption in Saudi Arabia.