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PRIVATIZATION OF THE ELECTRICTY SECTOR IN JORDAN: A CASE STUDY OF ON-SITE POWER GENERATION

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ABSTRACT

The Jordanian government has recently taken several steps towards the deregulation and privatization of the electricity sector in Jordan. Based on the new regulations, private electricity power generation is now possible, although with some limitations on purely Independent Power Producers (IPPs). Still the new regulations offer great economic and strategic opportunities for companies welling to invest in on-site power generation. The current study includes a technical and economical study of an on-site combined heat and electricity generation plant at the Nuqul Industrial Complex – JORDAN. This industrial complex houses three different industries: Al-Keena hygienic paper mill, MODAL Aluminum extrusion factory, and Quality Foods meet processing and packing factory. The three industries have common and high energy requirements, mainly electrical and process steam. The combined electrical and steam loads of the three industries presents an ideal case for on-site combined heat and electricity generation. The economic feasibility of such a project could only be achieved due to the recent deregulation of the electricity sector and the ability to sell the excess electrical power generated to the national grid.

Keywords: Deregulation of electric power industry, combined heat and power, on-site generation, feasibility study.

INTRODUCTION

Jordan is a rapidly growing country. According to the latest official figures, population growth rate is around 2.8%, the growth in the Gross National Product (GNP) is 5.3% [1]. The growth in the electricity demand is 8.2% and is expected to continue at a high rate in the near future, Figure (1). Until the mid 1990s, the Jordanian economy was mainly dominated by the public service sector and low technology light to medium conversion industries. The current trend in Jordan is toward privatization and high technology medium to heavy industries and large scale agricultural projects. This explains the high growth rate in electricity demand. A key ingredient to starting and maintaining such a growth is the sufficient supplies of electrical power at economical rates.

As part of economic recovery plan being implemented by the Jordanian government, several previously publicly held sectors have been or are in the process of being deregulated and privatized. This includes vital public sectors such as the electricity and communication sectors. Of interest to this study is the deregulation of the electricity power generation sector in Jordan. In October 2002 the government issued the new General Electricity Law [2]. This law lists the guidelines for the newly deregulated electricity sector in Jordan. The previously government owned and operated electricity sector has been divided into three independent segments: generation, transmission, and distribution. Only the transmission segment will remain under governmental control. This is due mainly to strategic and national security considerations. The National Electric Power Company (NEPCo) is responsible for the electricity transmission network in Jordan. All government owned electricity generation facilities have been grouped and placed under the umbrella of the Central Electricity Generation Company (CEGCo). This company will be privatized in due time and will have to compete in the near future with other privately owned power generation companies.

Due to the lack of competition in the electricity generation sector, the Single Supplier model is currently being implemented in Jordan and will continue for at least 10 years. Under this model the NEPCo is responsible for signing agreements with the different power generation companies and selling it in turn to the whole sale companies who in turn will sell the electricity to the end users. Under the current scheme, any new Independent Power Producers (IPPs) facility can only be established based on government studies of future electricity needs in Jordan and after going through the process of an international tender. This situation is expected to last for at least 10 years or until there are at least two new private IPPs other than the CEGCo. This clearly places a restriction on any national or international company that is interested in establishing an IPP in Jordan. Still under the current regulations, companies that opt to establish a private on-site electricity power generation facility are exempt from the need to wait for a government study of

future needs or to go through a biding process, but still need to obtain a power generation license. Also under the new regulation, such companies can sell their excess capacity to the NEPCo based on a long term agreement. Many companies around the world have been turning to on-site power generation to meet their needs of electricity, and sometimes process steam. On-site power generation can be more economical than buying the electricity, depending on the location and fuel(s) that will be used. Some companies are opting for on-site power generation based on strategic grounds in order to secure the needed electricity supplies for their activities. The new regulations in Jordan presents a new investment opportunity for large companies in Jordan in which they can achieve an economic return while achieving higher reliability levels in terms of electricity supply. It is for such a company that this study has been conducted.

This study was conducted at the Nuqul Industrial Complex, located around 50 kms south of Amman, the capital city of JORDAN. This complex houses three different industries: Al-Keena hygienic paper mill, MODAL Aluminum extrusion factory, and Quality Foods meet processing and packing factory. This complex is part of the Nuqul Group which is one of oldest, biggest, and most diverse industrial groups in Jordan. The complex was established in 1994 and since then has grown in terms of total production as well as the addition of new product lines. The complex will undergo several expansion projects in the short and medium term. Details of these projects can not be included herein due to their confidential nature. Yet there overall effect of these projects on the complex's energy requirements are included in this study.

TECHNICAL AND ECONOMIC ANALYSIS

Figure (2) shows the maximum and average electricity demand (MWh) while figure (3) shows the steam consumption (ton/h) for the Nuqul Industrial Complex. Based on these figures a 10 MWe, at site operating conditions, gas turbine combined heat and power plant (CHP) is proposed in this study. The gas turbine will run on Egyptian natural gas from the current undersea gas pipeline connecting the two countries. There are several commercial gas turbines available that meet this requirement such as Turbomech's TBM-M100 and Solar's Mars 100 units. Such CHP plants have proven them selves to be capable and viable in situations with similar energy requirements such as university campuses and pharmaceutical plants [3]. The economic study will be based on comparing the current situation of buying electricity from the grid as well as buying fossil fuel for the steam boilers versus the proposed CHP where electricity will be generated onsite with steam as a byproduct. All excess electrical power generated will be sold to the grid.

Based on data available in recent issues of the Gas Turbine World magazine of similar CHP plants, the budget price of the plant is set at 5,000,000 US$ with an annual M&O cost of 5% of the initial cost and a Low Heating Value (LHV) efficiency of 33% [4]. The current cost of the natural gas fuel is set at 2.4 US$ / million Btu. The current cost of buying electricity is 5.6 ¢ per kWh and the expected selling price of the excess capacity to the grid is estimated at 4.3 ¢ per kWh. Currently both fuel oil (at 111 US$ per ton) and diesel fuel (at 18.6 ¢ per liter) are used in the complex. The cost of the plant is amortized over 10 years at an interest rate of 10%. Figure (4) shows the annual cost of the current scenario, that of the proposed CHP plant, the revenue from selling the excess electricity produced, and the savings resulting from the use of an onsite CHP. The figure clearly shows the economic potential of the proposed CHP plant. Also clear is that the ability to sell the excess electricity is what made this proposal economically feasible.

Figure (5) shows the results of two sensitivity studies. The first deals with the rise in fuel cost while the second deals with the effect of rising interest rates. The fuel cost was raised by as much as 50% compared to the reference value above of 2.4 US$ / million Btu. The interest rates were raised from the reference value of 10% up to 20%. The results shown in Fig. (5) do not take into account the fact that the cost of purchasing electrical power and fossil fuels (fuel oil and diesel) will also increase if there was a rise in the fuel costs in Jordan. In reality a rise in fuel cost is expected to make the proposed CHP plant even more attractive. Although the rise in fuel cost will increase the cost of natural gas used to run the gas turbine this will be more than offset by the rise in the cost of purchasing electricity and fossil fuels as per the current situation. In all situations the steam used in the complex is being generated "for free" using heat recovery from the gas turbine exhaust gases. Thus the economics of boiler fossil fuel savings will become even greater. Also the cost of purchasing electricity from the grid will increase if the world fuel cost increases as the power producers will try to offset the rise in their fuel purchasing cost by passing it to the consumers. There are also other cost-saving measures that can be implemented that can further enhance the economics of an onsite CHP plant. In the current scenario, the cooling and freezing equipment used in the complex account for approximately 2% of the electrical power consumption. The overall efficiency of the CHP plant can be further increased by installing absorption type chillers as a bottoming cycle with the saved electrical power sold to the grid for increased revenue. Of course this option will need to factor in the cost of converting from electric compressors to absorption type cycles. This option has not been studied in details either.

CONCLUSIONS

The recent deregulation of the electricity industry in Jordan presented new economic opportunities for on-site power generation plants. A technical and economical study was performed for a proposed combined heat and power (CHP) plant at the Nuqul Industrial Complex – JORDAN. The industries housed in the complex use large amounts of electricity and process steam. A CHP plant was sized and proposed to cover both the electrical and steam requirements of the complex with the excess electricity being sold to the grid. An economic analysis of the proposed plant revealed the viability of such a proposal. This proposal would not have economically viable had it not been for the new deregulation laws.

ACKNOWLEDGMENT

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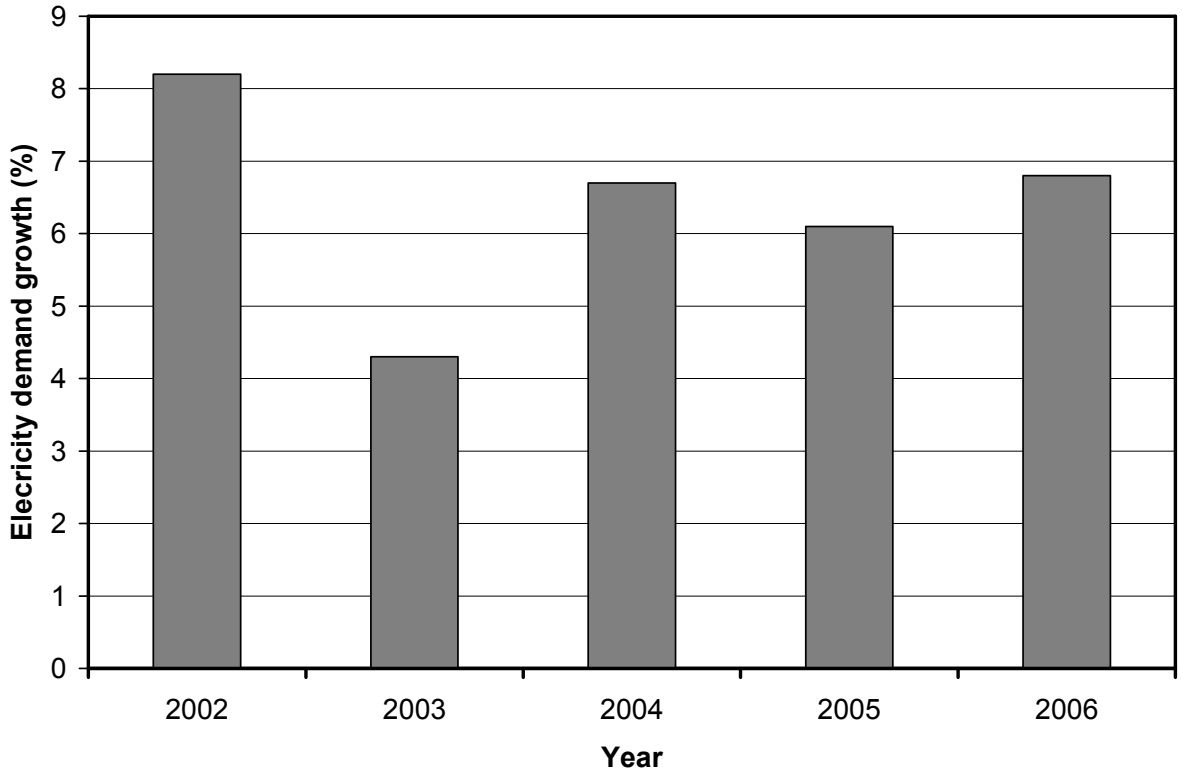

Figure 1. Growth in electricity demand in Jordan [1].

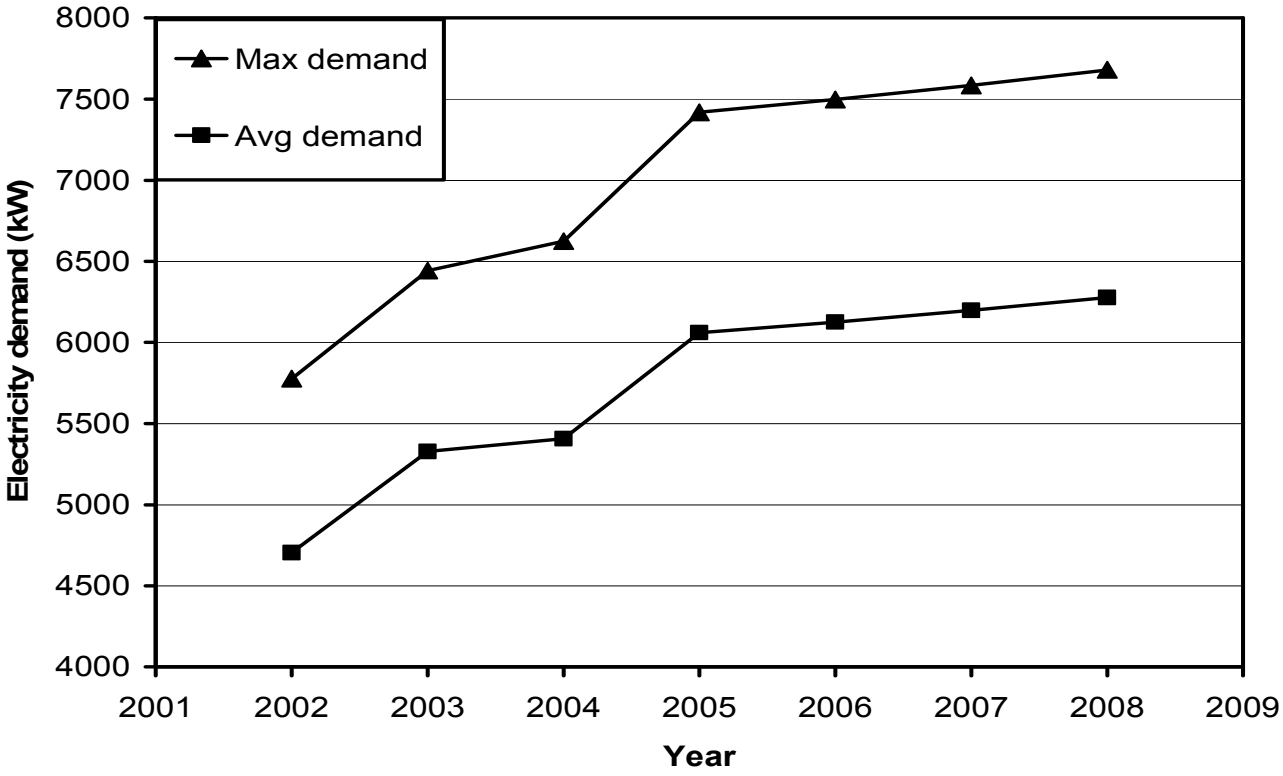

Figure 2. Maximum and average electricity demand at the Nuqul Industrial Complex.

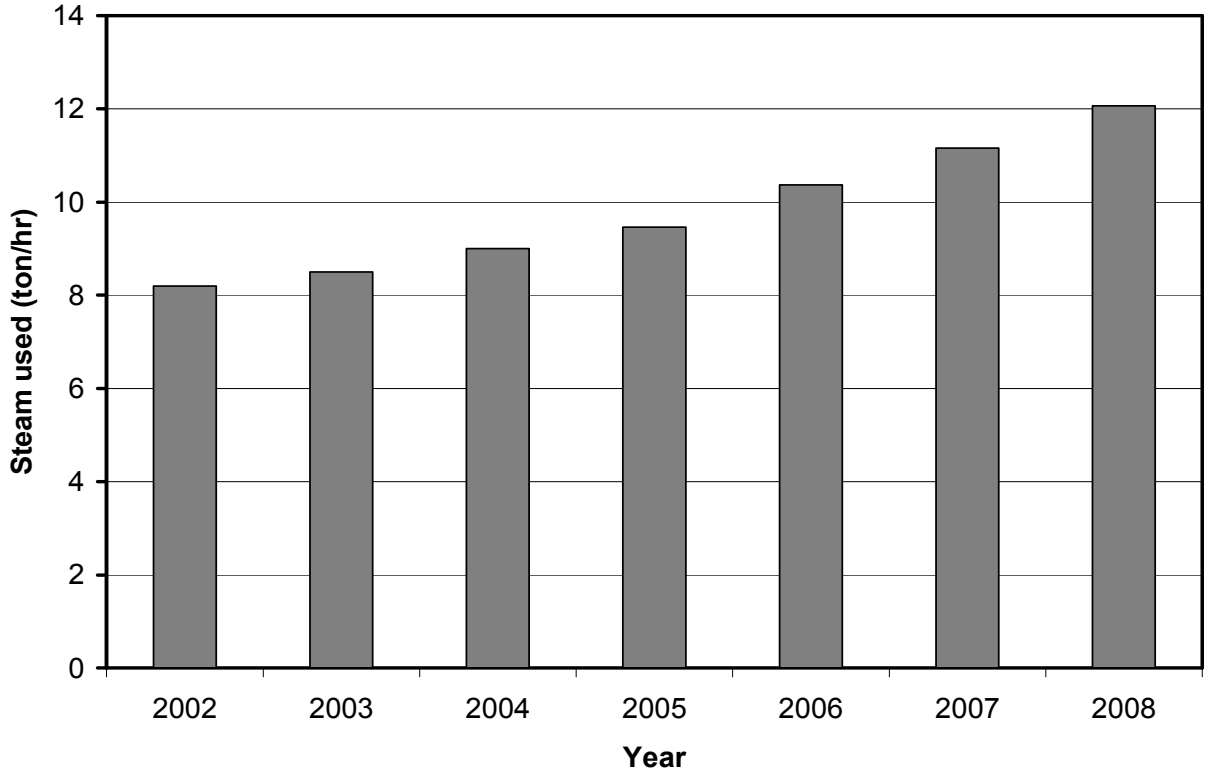

Figure 3. Total process steam used at the Nuqul Industrial Complex.

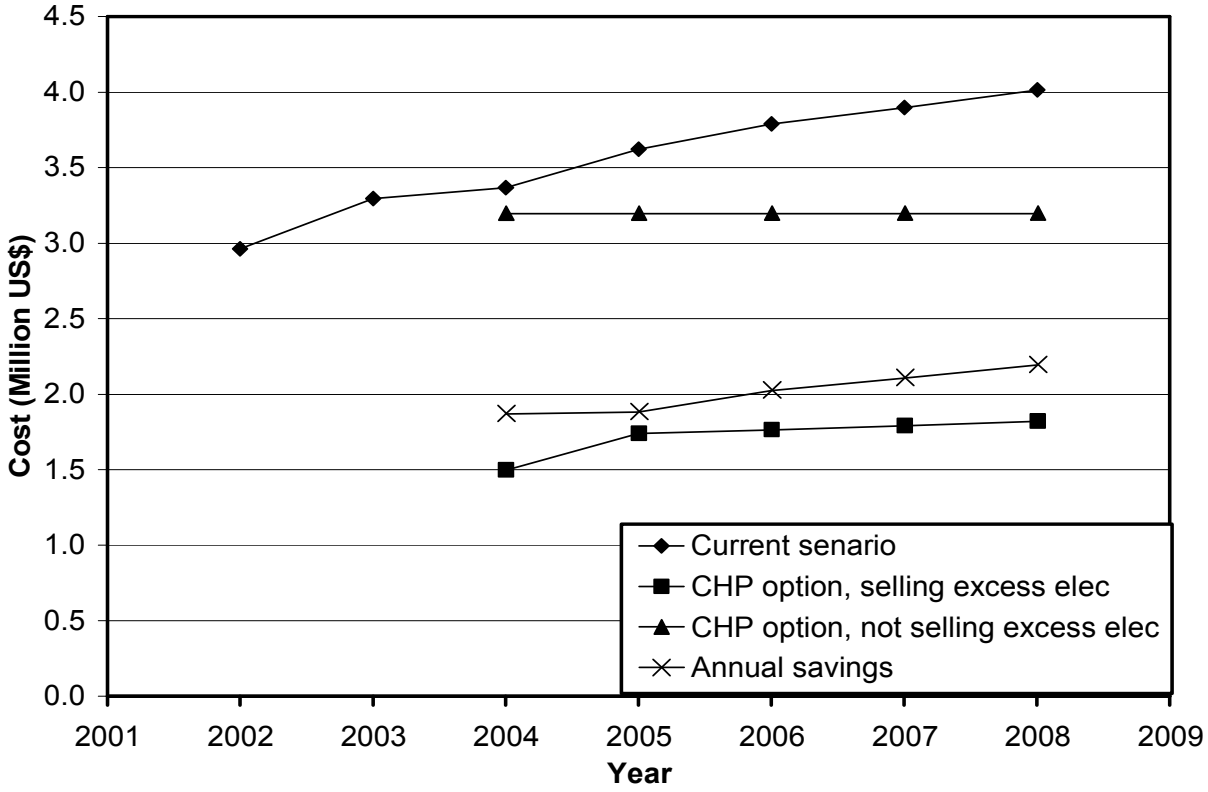

Figure 4. Comparison of the total cost of the current scenario with the proposed CHP plant, with & without selling excess electricity, and the resulting annual savings.

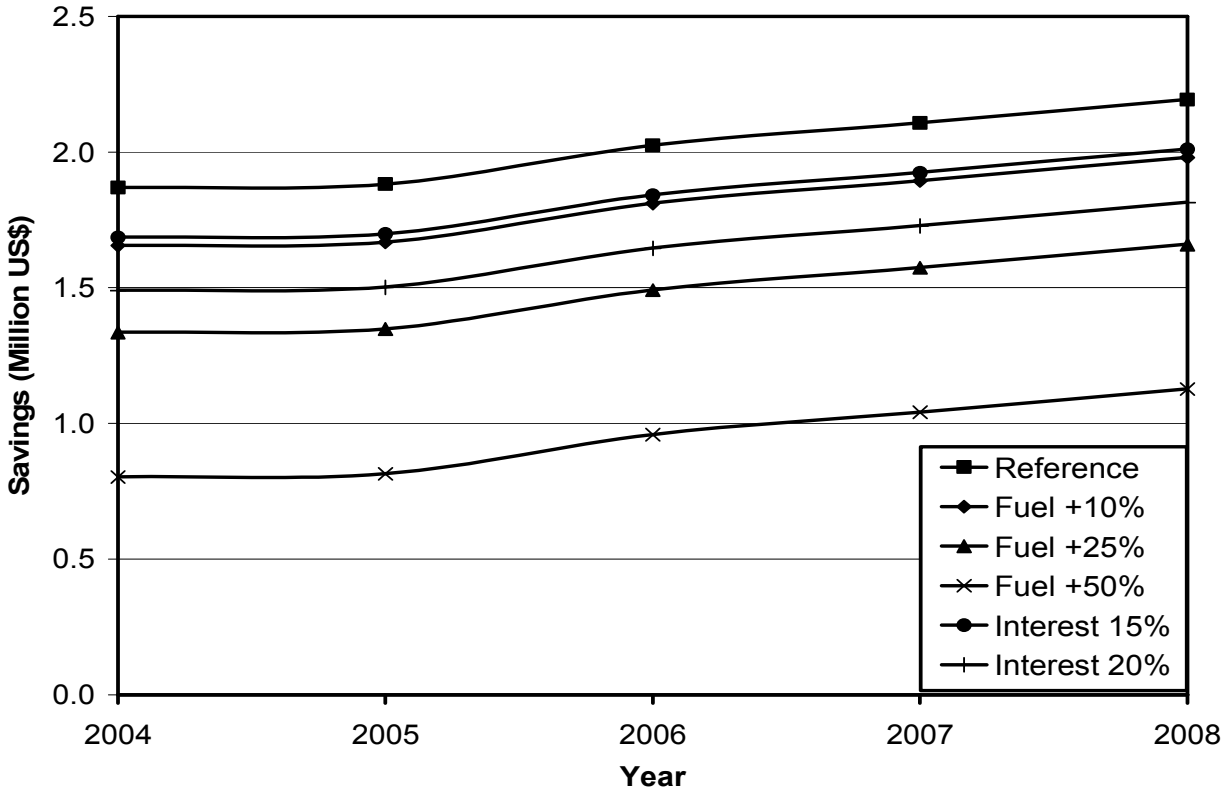

Figure 5. Sensitivity analysis showing effect of rises in fuel cost and interest rate.