

# GCC Power Grid: Transforming the GCC Power Sector into a Major Energy Trading Market

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**Abstract** – The Gulf Cooperation Council (GCC) countries namely the United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar, and Kuwait have been undergoing transformational changes to their power sectors as a result of increasing demands for power due to rapid population, commercial and industrial growth in their respective countries. Realizing the financial burden to construct utility projects to meet such demand, the governments of the GCC countries have embarked on a plan to restructure and privatize their power sectors thus encouraging the private sector to invest in this lucrative industry. Legislation has been passed in several GCC countries to restructure and privatize their power sectors into separate generation, transmission and distribution entities. The GCC countries have also established a Power Grid Authority known as the GCC Interconnection Authority to develop the GCC Power grid. The power grid will reduce high long-term investment costs in constructing generation plants by reducing the level of reserves needed in each country as well as providing wheeling services and enabling energy trading. By providing trading services to the power sector, the GCC Interconnection Authority will have then become the ‘launch pad’ for energy trading, not only, between the GCC countries but with IWPP’s and other power grids such as the Pan-Arab, European and Mediterranean Grids; making the GCC region into a major exporter of power and thus enhancing the economies of the GCC countries. This paper describes the transformation of the power industry in the GCC countries; the establishment of the GCC Interconnection Authority as well as the GCC Grid; its advantages to the GCC power industry; and its implication in transforming the GCC power sector into a major energy trading market.

**Index Terms** – energy trading, generation, interconnection, GCC, IWPP, power grids, power sector, privatization, restructuring, transmission, WTO.

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## I. INTRODUCTION

Formed in 1981, the Gulf Cooperation Council, otherwise known as the GCC, consisting of the six Arab Gulf countries namely, the United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar and Kuwait with the objective to develop and solidify the political, economical and social ties among the member countries. With oil-based economies the GCC region has been experiencing major economic growth providing financial incentives to its citizens, thus resulting in high population growth and vast commercial and industrial activity, henceforth leading to increasing demand in utility services.

The current demand for electrical power in the GCC countries is approximately 60,000 MW and is expected to triple over the next 25 years.

## II. POWER SECTOR STATUS IN THE GCC COUNTRIES

Realizing the financial burden the GCC countries are experiencing presently and in the future to meet power sector demands the GCC countries, with the exception of Kuwait, have embarked on unbundling their power sectors into separate generation, transmission and distribution segments thus providing opportunity for these business segments to focus on their core business, and also encouraging capital investments from the private sector. Reform efforts in most of the GCC countries are limited to opening up the power sector for private investment in generation, transmission and distribution however; much consideration is given by the GCC governments with Oman leading the way by implementing laws to facilitate reform.

The process of unbundling the power sectors in the GCC region is currently under consideration by some of the member countries.

### United Arab Emirates

With the rapid increase in the demand for electric power in the Emirates it led to the formation of a privatization committee for both the power and water sectors. Abu-Dhabi, one of the Emirates in UAE, has already implemented functional separation, and separate generation, transmission and distribution companies exist.

There are several IWPP's however; both the transmission and distribution segments are not privatized. Although several reforms have been implemented during the past few years there are no plans to further privatize the sector in the Emirate of Abu Dhabi. The other electricity authorities in the UAE have also no restructuring plans in the near future.

#### Bahrain

The Ministry of Electricity and Water is responsible for the generation, transmission and distribution of electricity in the Kingdom; however it is reforming its power sector. Bahrain has allowed private sector participation in generation and is currently considering the privatization of its utilities sector which is government controlled. It intends to establish a regulator to ensure that private sector participation leads to the effective development of the electrical power sector in the country.

#### Saudi Arabia

As a result of Royal decree in year 2000 the Saudi Electricity Company was established as a result of merging the ten regional power companies which were responsible for the Kingdom's power supply. However, to provide opportunities to the private sector to compete and alleviate the financial burden for investments to meet power demands the government has permitted the private sector to invest in power generation. The formation of Marafiq in the industrial cities of Jubail and Yanbu, the construction of several IPP's such as the construction of a 230 MW cogeneration plant for the Saudi Petrochemical Co. in Jubail, and the establishment of the Water & Power Corporation (WEC) in the Western Province of the country has been a major boost to privatization. The WEC has constructed an IWPP in Shuaibah and seeking to construct an 850 MW IWPP in Shuqaiq, thus becoming significant achievements to the developments of the sector.

In terms of reforms the government is currently restructuring the industry by unbundling the electric sector into separate generation, transmission and distribution functions with the partial unbundling on a management level of SEC complete.

As part of the restructuring process, the Electricity Services Regulatory Authority (ESRA) was established in November 2001. The ESRA is responsible for the regulating supply of electricity, issuance of licenses for electricity projects, ensuring compliance with conditions of licenses, and the protection of rights of consumers, investors, producers, transporters and distributors.

#### Oman

Previously the Ministry of Housing, Electricity and Water was responsible for the whole electricity supply until in August 2005 when a sector law decree went into effect by further driving the privatization of the power sector and opening the more opportunity for private investors. In Oman the operational responsibility for the electricity sector has been transferred from the Ministry to newly created generation, transmission and distribution companies such as the newly formed Oman Power and Water procurement Co. and the Oman Electricity Transmission Company. The government does not plan to privatize the procurement company however plans are underway to privatize the transmission and distribution side of the sector.

In general, the GCC countries are reforming their power sectors in order to allow competition at the generation level through the introduction of IPP's and IWPP's and to establish separation in their current single-buyer market to introduce more competition.

#### Qatar

The government has already initiated a programme for the restructuring and privatization of the electricity sector. Functional separation of generation, transmission and distribution has been allowed along with private sector participation. The Qatar General Electricity and Water Corporation (Kahramaa) is responsible for the transmission and distribution segments, whereas generation has been transferred to the newly formed Qatar Electricity & Water Co. The government grants licenses to private sector entities to build generation plants. The government is currently studying the possibility of privatizing (Kahramaa) and forming a transmission and distribution company.

#### Kuwait

The power sector is controlled by the Ministry of Energy and is responsible for the operation, development and expansion of the sector. The electric supply industry is state-owned and has a vertically integrated structure. Although its annual electricity demands are amongst the highest in the GCC region the Kuwaiti government has so far no plans to restructure the electric power sector in the future and likely to remain vertically integrated.

Table 1 summarizes the status of the power sector in the GCC countries:

TABLE 1  
STATUS OF POWER SECTOR REFORM IN EACH GCC COUNTRY

GCC Country	Degree of Unbundling	Reform Efforts
Kuwait	Unbundling Not Planned	No Reform Plans
Saudi Arabia	Partial Unbundling (Management Level)	Reform currently under Progress
Bahrain	Under Consideration	Plans to Privatize Sector
Qatar	Separate G (QEWC) T&D (Kahramaa)	Privatization of Kahramaa under study
UAE	No Unbundling Separate G, T & D for Abu Dhabi	Reform in Abu Dhabi No Reform Plans in other Emirates
Oman	Separate G, T & D Companies	Laws in place to facilitate Reform

III. FORMATION OF THE GCC INTERCONNECTION

Since 1982 the plan to interconnect the power grid systems of the GCC countries had been evoked and, as a result, several studies were conducted by various local GCC and international consultants to analyze the feasibility of the grid from a technical and economical perspective. Based on the 1990 and other subsequent studies it has been demonstrated that the interconnection among the GCC member countries is technically feasible as well as economically viable. This led to the formal establishment of the GCC Interconnection Authority (GCCIA) in 2001 by Royal Decree from the six GCC countries.

The main objectives of the GCCIA are to construct, operate and maintain the interconnection. The construction stages consisted of establishing the GCCIA office and hiring of highly efficient staff, to manage the tendering of contracts, and overseeing the construction of the interconnection project.

The interconnection project was planned to be realized in different phases based on the interconnection topology explained below. The first phase concerns the interconnection of the Bahrain, Saudi Arabia, Qatar and Kuwait, and Phase III will then interconnect Oman and the UAE power systems with the countries involved in phase I. The reason for the construction of the interconnection in phases was to give the UAE and Oman time to interconnect their internal systems. Two basic topologies were used for the interconnection namely: the neighbor to neighbor topology and the common link topology. The 'neighbor to neighbor' topology principle is to tie one power system to another like in the case of Oman and the UAE. In the 'common link' topology each

system is tied to the link, providing direct access to any other interconnected system like in the case for the phase I interconnection. However, the chosen interconnection topology for the GCC grid consisted of a mix of the two basic topologies which joins in the 'common link' representing the phase I interconnection of Bahrain, Saudi Arabia, Qatar, Kuwait and the UAE, and the 'neighbor to neighbor' between Oman and the UAE, forming the 'hybrid link'. This 'hybrid link' will provide all countries direct access to any other system except that of Oman, which will require all transactions with the other five GCC countries the use of the UAE power system.

Evidently, to get the maximum benefits of the GCC countries it will require that the internal power systems of the UAE and Oman be integrated. For that reason, a Phase II of the GCC Interconnection project was necessitated to ensure that the UAE and Oman internally integrate their networks as a preliminary step to the formation of the 'hybrid link'. Henceforth, the phases for constructing the GCC grid are:-

- Phase I: Interconnection of Kuwait, Saudi Arabia, Bahrain and Qatar; known as the Northern System.
- Phase II: The internal interconnection of the UAE (forming the UAE National Grid) and Oman (forming the Oman Northern Grid). These are known as the Southern Systems.
- Phase III: Interconnection of the Northern and Southern Systems in 2010. Forming the Hybrid link.

Since the internal interconnection of the UAE has been completed much consideration is being given to integrate the UAE with the Phase-I interconnection. With the interconnection of the UAE to the Phase-I countries will form the GCC 'common link' segment of the GCC 'hybrid link' interconnection.

Figure 1 depicts the geographical layout of the GCC Interconnection:

FIGURE 1  
LAYOUT OF THE GCC INTERCONNECTION HYBRID LINK



## V. BENEFITS OF THE GCC INTERCONNECTION

Associated with the development of power interconnection are several benefits whether they are economical, environmental and technological. The economic benefits of interconnections have historically been providing improved security of power supply and better economic efficiency.

The security of power supply is considered to be the main purpose of constructing power interconnection between countries by sharing generation reserves and installed capacity in order to reduce additional investments in generation infrastructure. The interconnection can also provide countries and/or regions an alternative source for operating reserves and support during emergencies. In addition to providing access to operational reserves, power interconnections can provide diversity to the available sources of energy supply. Instead of depending on domestic resources for energy (ex.) fossil fuels, gas, etc, an interconnection can increase system reliability through the importation of a different energy resource such as nuclear and hydro power to the receiving country. In the case of certain fuels or resources such as hydro power, and other renewable resources an interconnection is the only feasible means of making such resources available to other areas leading to the development of these diverse energy resources for the benefit of the entire region, thus allowing less costly power to be delivered from distant locations, often displacing important, expensive fossil fuels and utility projects. Subsequent to providing improved security of power supply, interconnections have gained importance as a mechanism to improve the economic efficiency of power systems. With the development of power interconnections, individual power systems can be operated and expanded as part of a larger regional system thereby providing countries with income through the export of excess power to other countries and regions. Due to the large availability of gas and crude oil for power generation in the GCC countries the potential of exchanging economic energy between the power systems exists.

## V. DEVELOPING THE GCC ELECTRICITY MARKET

Long ago, the GCC region was traditionally run by vertically integrated utilities with the obligation to supply electricity to all its customers in their territories. The utility was generally owned by a national, regional or local government, or by both private investors and government as in the case of Saudi Electricity Co. As mentioned in section II most of the GCC countries, are moving towards unbundling and reforming their power sectors. Reasons for such a move are:

- Need for increased operational efficiency;
- Traditionally regulated industry led to high electricity prices;

- Private owners can respond much faster to economic and technological change than government owned utilities.
- Most importantly nationally owned power sector require investments that could not be funded by the state, so, new private initiatives are required to enhance investment and the implementation of projects based on future demand.

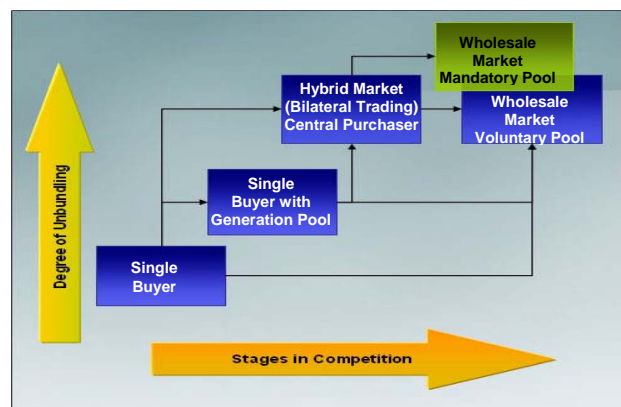
With many GCC countries joining the WTO their economies must be competitive on a global scale thus requiring a reduction in input costs (i.e.) electricity, for their industries, they have embarked on the road to reforming their electricity sectors as well as initiating the development of a gradually competitive market. The presence of the GCC Interconnection Authority will thus enhance further cooperation between the member country's utilities leading the way to establishing a common market in the region.

The development of the GCC electricity market is a step-by-step process. This approach is considered to be the most effective and efficient manner of achieving the full benefits of the interconnection of the electric power systems of the GCC countries. In order for the GCC countries are required to establish a regional market they must carryout the following measures in sequence as follows:

1. Allow competition at entry in generation through introduction of IPP's and setup a single buyer;
2. Establish vertical and/or horizontal separation to enhance competition.
3. Establish open access to transmission to allow generators to wheel power to distributors and large customers.
4. Form a national and ultimately a regional power pool or wholesale market.

Figure 2 illustrates the general transitional stages from the single buyer to the competitive (wholesale) market:

FIGURE 2  
TRANSITIONAL STAGES FROM SINGLE BUYER TO  
WHOLESALE MARKET



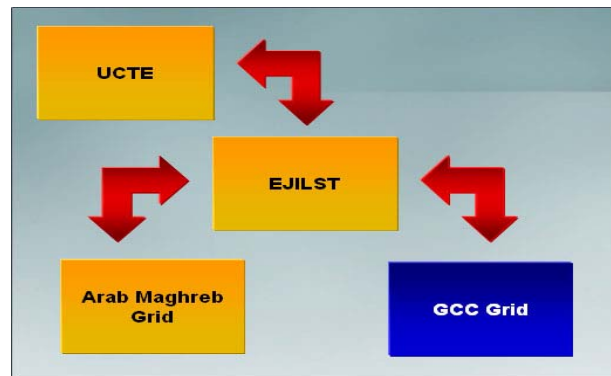
Although uniform reforms in each member country are not necessary, however it can be argued that long-term sector reform would help to introduce more efficiency and competition into the regional market thus enabling the regional trade to realize its full potential.

The political will to create trading opportunities is a fundamental pre-requisite for developing a regional electricity market followed by economic and technical matters. However, other aspects in developing a power market (i.e.) technical, legal and commercial would have to be taken into consideration.

#### VI. BENEFITS OF THE GCC ELECTRICITY MARKET

Besides the usual benefits the GCC Interconnection will provide, a common GCC electricity market will ultimately provide a number of benefits to the GCC. Newly reformed laws will promote participation of local and external investors and of other GCC and neighboring countries resulting in lower production costs as a way to achieve lower electricity prices. Another driver is to allow private investors to develop larger projects with access to a larger market, including not only the GCC but other pools such as the EJILST (Egypt, Jordan, Iraq, Lebanon, Syria, and Turkey) and the UCTE (Europe). The availability of a common market will also provide opportunity for the establishment of power plants close to resources such as fuels. Thus giving freedom for IPP's or IWPP's to select a strategic location realizing the potential in dealing with a larger market and thus facing lower risks. A good example would be the construction of a power plant operated by Qatari natural gas and transmitting it to regions with high demand. By extending the GCC grid to other grids such as the EJILST or the Maghreb Arab Grid can provide opportunity to export surplus power to other regions. A good example is the export of power from the GCC region during winters when demand is low to regions in Europe where power demand is high. The market will also encourage energy interchange during seasonal diversity when need of power in the GCC region during the hot summer seasons can be imported from regions where demand is low as shown in figure 2. The development of a regional market via the GCC grid can provide alternative solutions to exporting of power by wheeling as opposed to exporting power by a pipeline (i.e.) natural gas pipeline.

FIGURE 2  
POTENTIAL REGIONAL INTERCONNECTIONS



#### VII. CONCLUSIONS

With the reform of the power sector currently in process and the development of the GCC Power Grid will be considered to be a fundamental step to the liberalization of a regional power market. The GCC interconnection will act as a gateway towards a regional and pan-Arab power pools, thus encouraging the GCC countries to develop a regional power market and henceforth promoting social, economic and environmental development and cooperation in the Middle East and North African countries.

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#### IX. BIOGRAPHIES

**Hassan Al-Asaad** graduated in 1994 with a bachelor's degree from the University of Manitoba, Canada and had pursued a Masters of Business Administration in 1999 from Sheffield Hallam University in the U.K. He had worked as a business and management consultant for Arthur Andersen & Co. in the GCC region for several years. During which he had engaged in providing a range of consultancy services from organization re-structuring to I.T systems implementation to various industries in the GCC region specifically to the oil & gas and utilities industries. In 2002 he moved on to be one of the first employees of the GCC Interconnection Authority playing a major role in developing it from the pre-construction to construction phase. He is currently head of projects, planning, and information technology services.

**Adnan Al-Mohaisen** graduated from King Saud University in Riyadh, Saudi Arabia in 1976 with a bachelor's degree in Electrical Engineering. Upon graduation he was among the first to be hired in the Royal Commission for Jubail & Yanbu. Thereon, he worked in various positions and in 1980 managed to attain, by scholarship, a Masters degree in Electrical Engineering (Power Systems) from the University of Missouri in 1981. During the 29 years that he was with the Royal

Commission for Jubail & Yanbu, Adnan held 3 senior positions of Deputy Director General in the Planning & Projects, Community Services and Public Services areas. In late 2004, Adnan was nominated to become General Manager for the GCC Interconnection Authority in which he took the position in January 2005. Adnan also headed and participated in various committees in the Royal Commission and other public organizations. Adnan has also participated in management and career development courses from various reputable universities, such as the University of Chicago and the University of Southern California and the University of New South Wales in Australia.

**Satish Sud** graduated in 1967 with a B.Tech. (Honors) in Electrical Engineering from the Indian Institute of Technology, Kharagpur, India and obtained his M.Sc. in Engineering from the University of Manitoba, Winnipeg, Canada in 1969. He is Vice President of Power Systems in the Energy Division of SNC-Lavalin. He is an electrical engineer with over 36 years of experience and is responsible for the development and management of the Power Systems Group which undertakes electrical transmission and distribution projects, electrical system and energy studies, master plans, power sector reform and restructuring studies, and economic and financial studies. He has directed numerous electrical generation, transmission planning and system design studies, both in Canada and overseas. He was the project manager for the planning studies to determine the techno-economic feasibility of various interconnection projects where both AC and DC alternatives were considered. He has also developed master plans for electrification and national energy plans for several countries. Some of the countries in which he has participated in planning studies and/or projects are: Canada, USA, Honduras, El Salvador, Nicaragua, Panama, Guyana, Argentina, Peru, Senegal, Mauritania, Mali, Guinea, Ivory Coast, Cameroon, Niger, Nigeria, Benin, Togo, Rwanda, Tanzania, Botswana, Zambia, Zimbabwe, Kuwait, Saudi Arabia, Bahrain, Qatar, United Arab Emirates, Oman, Iraq, China, India, Philippines, Indonesia, Vietnam and nine countries of south eastern Europe. He is a member of the Order of Engineers of Quebec, Institute of Electrical and Electronic Engineers and the Institution of Electrical Engineers (Fellow).