UNITED NATIONS

E

ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED
E/ESCWA/ENR/2002/WG.2/21
15 October 2002
ORIGINAL: ENGLISH

Economic and Social Commission for Western Asia

Expert Group Meeting on Capacity-Building and Regional Integration for Developing a Sustainable Energy Sector
Beirut, 15-16 October 2002

ROLE OF NATURAL GAS IN LEBANON: PROSPECTS AND FUTURE SUSTAINABLE DEVELOPMENT

02-0677

Role of Natural Gas in Lebanon: Prospects and Future Sustainable Development

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Foreword

The real world of energy decisions is not quite an easily defined plan. Plans are based on forecasts; they are drafted to span a time frame with assumption about possible evolution of key parameter e.g. macro-economic performance, a range of possible future and lead the country to different findings of energy supply and demand. In the long term approach, Lebanon is trying to adapt its strategy to present the realities of what is available, what cost, what expected growth and what we expect in the future. In order to attempt to identify a plausible future, that is available, cost effective, environmental friendly, we should consider the activities that could affect the different scenarios as economic activities, new technologies in the energy sector, prices and costs, size of the supplier known reserves, balance of payments, and governmental policies. These policies will be seeking economic, environmental, political and social advantages for the Lebanese.

The challenge to the MEW in the short-term is to turn EDL around to achieve financial viability through operational efficiency improvements to minimize the sector's financial impacts on the budget and to undertake the fundamental reforms and restructuring of the sector, and to attract private investment critical to improving and sustaining the development of the energy sector. The positive economic impacts will be seen through least-cost energy supply, such as the natural gas evoked in this paper that will contribute to the government budget, and thus enabling additional public funds for social projects.

Introduction

Policy on Natural Gas varies widely from country to country. Energy policy in Lebanon during this decade is set on course for fundamental changes to ensure secure, diverse and sustainable supplies of energy in the manner that businesses and people want, and of course at competitive prices. Natural gas of course will be promoted to support the sustainable energy development of Lebanon.

In this connection with the sustainable energy development; social, economical, and environmental aspects have to be considered on energy development including production, transportation, and consumption. Therefore, natural gas will have a very important role in the national economy development in Lebanon. The sustainability of the energy supply capacity of these fuel resources needs to be considered as part of the Ministry of Energy & Water national plan. For this purpose, energy supply options for the sustainable energy development in Lebanon have to be analyzed.

As most of the new and renewable energies has economical and technological barriers for the sustainable energy development, the analysis of the energy supply options can be focused on the existing energy sources that have been commonly utilized such as biomass renewable energy, natural gas products, and oil products.

The decision by the Lebanese Government to use natural gas is based on an overall economic assessment of natural gas use against alternative energy sources consumed. Alternatively, marketing the natural gas in Lebanon once it is used at the utility level and other sectors, it could enhance drastically the economics of this overall project report since most countries or operators using gas in their power sector are

using productively this valuable commodity with sufficient transparency to customers and competitively prices.

It's worth to mention that the residential (city gas) and the commercial sectors also could benefit greatly and would have in the medium to long term substantial savings and positive impact on the economical, social and environmental parameters in switching to natural gas.

Ministry of Energy & Water/ Electricite du Liban (MEW/EDL) proposed deregulation is expected to bring out rapid changes in the charter and operation of EDL, MEW and their interaction with Lebanese customers.

Traditional electric companies are consolidating and reorganizing to become combined gas and electric utilities, and in some cases like in Lebanon a total utility service providing water, gas and electricity. The basic structure of power generation, transmission and servicing is being revised by the actual Government to provide value to customer-oriented solutions. These changes are accelerated by the high cost of replacing aging power generation plants, i.e. Jieh, Hreiche, Zouk (becoming old and high operating-cost plants) and environmental concerns over the installation of 220 KV transmission lines for new central power generation systems, and the growing customer need for reliable and high-quality power for advanced energy sources. Natural gas can readily fuel the evolving distributed power generation technologies i.e. in Zahrani and Beddawi and explore the available information on power production and some of the critical hurdles to commercialization of the fuel to be used.

An important feature in the energy sector outlines that in most OECD countries, natural gas and electricity utilities have converged. Recent examples are when multinationals are integrating their gas and power division into one and the new IPP's or the utilities are offering both commodities gas and electricity both, to their potential purchasers. Changes have been taking place in this respect, where for the last decades, the state-owned utilities were very conservative in their policy.

Recently, the several concerned governments have decided that private sector involvement and privatization, would reduce their respective government borrowings, needs, and produce some fresh cash to their respective treasuries. Hence, is to let the operator run their operation, bring attract efficiency, bring competition and therefore select their choice fuel, i.e. Natural Gas.

The process of this change has already started in the Middle East and North Africa regions (MENA). We can observe here that the energy industry will become more focused on competition, transparency and allow the "**Eligible Customers**" choose between many suppliers.

It's worth mentioning that the implications for the Electricity and the Gas industry are in more of choices such as generation, cheaper consumer prices (i.e. the reduction in prices will affect the overall gas – electricity chain), and a definite improved efficiency. In the U.S. and in some European countries for example, both commodities could be purchased from the same trading supply outfit.

Since EDL or the Lebanese Power Sector is found to be a substantial candidate, for the gas-program star-up, this paper takes a deep look at the economical, financial and environmental evaluation of the power sector.

With the recent regional natural gas development and it's abundances in the neighboring middle eastern countries such as Syria, Saudi Arabia, Egypt , Qatar and Iraq, the gas export is rapidly increasing. The Levant region still lacks the gas for its electricity generation and need to start playing its role in this region for a winning approach and sustainable development.

Since EDL on the Lebanese Energy Sector is a substantial candidate for a gas project start-up, this study takes a deep look of the economical, financial and environmental evaluation of the power sector.

This paper will show the several benefits the Lebanese government would achieve if this growing subject scheme and market opportunity, are implemented. Regardless of the outlined scenarios, proposals and options, contained here in this process will further strengthen our joint cooperation and the regional integration of our energy trading business with Syria for short, medium and long term. The several sensitivity analysis will demonstrate the actual cost our national utility EDL is incurring versus the future savings EDL/MOF will have when and if MEW/EDL switch partially and or all our power plants to natural gas. This of course has been done taking into consideration the deregulation of our energy market and having MEW play a big role in the growth process by positioning Lebanon a player in the short and long term in the gas market. This report has been conducted without taking into account at this stage the Tyr and Baalbeck power plants consumption.

The change in policy is also taking into account the effects on demand for fossil fuels when EDL's privatization is complete. From bringing the electricity tariff down or using cleaner fuel, there will be major changes that will take place when the operator(s) or the new strategic partners decreed by the law # 462 dated 05/09/2002, will be in charge of the sector. In this respect there should be some obvious solutions when it comes to the investment risks to be shared between gas utilities, gas consumers and or gas producers, specially there is a competitive gas market with a number of buyers and sellers, then only commercial risks remains.

However, as electricity privatization is approaching and the energy sector restructuring, it will become necessary that the government takes a firm commitment for the process implementation, given the large capital expenditure involved, to have the private sector comply using cheaper methods for fuel supply. It would be wise to anticipate the future maturing of the gas market and the consequent competitive tools that the "Regulatory Agency" will introduce into this new market and adjust the natural gas contracts accordingly.

In this respect, it is recognized by all parties here, that the favorable contract condition on natural gas with Syria Petroleum Co. (SPC) will succeed in providing MEW for a long-term solution to EDL's problem, thus supporting Lebanon's sustainable energy development.

This paper has considered as EDL has advised previously, a 4%-5% of thermal electricity growth for the Lebanese domestic demand. You will notice from attachments I and II (pages 8/9 and pages 10 to 13) the various options taken in the evaluation process which is quite extensive specially since the considered years were 95,96,97,98, for the Mediterranean Genoa/Lavera petroleum products prices (Fuel Oil and Gas Oil). Having taken the average of Mediterranean - Basis Italy, cargoes petroleum product prices for the years 1999-2001, having chosen one option for the Brent at US$ 15/barrel, the second one, with the Brent at US$ 18/barrel, the third one with the Brent at US$20/barrel, and the fourth one with the Brent at US$26/barrel. The history of crude prices shows that the US$ 10/Barrel has only been seen for a very short period. The average for the last ten years (1988 - 1998) and the last 12 years were done (1988-2001) are shown in attachment I-A and attachment I-B, shows an US$ 18.04 average price and an US$ 19.04 average price, respectively.

The total consumption without Tyr and Baalbeck Power Plants, for Beddaoui, Hreiche, Zouk, Jieh and Zahrani Power Plants amounts to +/- 2,300,000 TOE/year (or TPE). With this base case for the several options, Lebanon is projected to need around 3.3 Billion CM per year by 2020-2023.

MEW is also starting to conduct the first stage of exploratory work and technical assistance, such as seismic acquisition and stratigraphic drilling as part of the geological/geophysical survey needed for the Lebanese offshore zone. Serious discussions are being initiated for appropriate financial and institutional assistance by government and international organizations such the World Bank, IFC, EIB to break the "chicken and egg" relationship between upstream investment and infrastructure construction.

The effects on the gas market infrastructure expansion, especially those of pipelines including the "city gas" for Greater Beirut, Tripoli, Saida and other cities, should be fully evaluated from the long term perspective.

When this is achieved, the Lebanese gas market will become as a reality a first step waiting to open up in the future to competition in order to let the industrial customers enjoy the benefit of competition as mentioned earlier. The Lebanese specific shares of natural gas will be restricted in this paper mainly to generate electricity for the selected years which are contained in pages 50-52 The generation of electricity power is an important source of demand for this becoming preferred fuel for CCGT as Zahrani and Beddawi power plants. For example, in Asia, despite the Asian Economic crisis of 1997/1998 and the decline of the region economic growth, Singapore, South Korea, Malaysia, Indonesia and Taiwan are increasing now their natural gas consumption to generate electricity compared with the last 15-20 year period. More Asian countries will also develop their energy consumption once they will be accessible to more gas pipelines from Russia or Iran and with more LNG terminals that are under design and/or commissioning in this period for their market.

Expression of strong political leadership by Lebanon for the development and utilization of natural gas in the electricity generation mainly, as well as the establishment of consensus and a multi-national cooperative relationship among exporting countries to proceed in a unified manner would be needed to have these energy related efforts to succeed. Emphasis should be put on the need for an institutional and regulatory framework dedicated to natural gas, its import and downstream activities. Once these institutional reforms are complete and achieved without endangering the provision of public services, this will attract international participation, bring the costs of generation down and will facilitate financing and the preparation for the several proposals for the next steps and other prospective projects. As far as down stream activities are concerned, dedicated regulation should also be put in place. Main topics would include the structure of the gas industry, competitive access to market (for the industry) and to product (for customers), economic regulation (prices and tariffs) as well as technical, safety and environmental standards.

Due to its geographical location, Lebanon has several options to consider as complementary to the Syrian gas supply (see page 36). The Syrian gas will provide Lebanon with a secured long term supply contract and the gas move will cement further the economical relations with Syria. In order to meet all the demand, MEW would be considering other options than the overland GASYLE pipeline for Syria and would consider the Egyptian alternative or potential LNG supply that is already offered to the Lebanese Government.

The major advantages to the natural gas shift in the Lebanese energy sector liberalization are outlined in various techno/economical facts outlining the clean properties of this commodity compared to other petroleum fuels together with the, nowadays concerns, about the pollution and other positive properties, highlighting here the sustainable development of this sector. Recent technological developments have already made positive contribution to the natural gas industry both in the drilling production phase and its transportation, whether to power plants, industries, cities, by pipelines or by ships.

This constructive move will be serving the interest of the Lebanese society as the Lebanese Government is keen on achieving liberalization and public policy to support the natural gas utilization to meet Lebanon's environmental, economical and social energy demand to ensure an appropriate and adequate energy services accessibility, affordable costs, environmentally secure for Lebanon's future sustainable development.

I. ACTUAL SITUATION, COST PER KWH WITH AND W/O NATURAL GAS

With the ongoing deregulation of several international natural gas markets that took place in the 90's, and still ongoing now, this has increased the globalization of the gas trade. Another reason for this

development is that it is based on economical and technical factors, as is the case now for many emerging countries. It is worth mentioning here, that the volume and the speed of the ***"dash for gas"*** in larger volumes every year was the result for the energy policy of promoting competition. Considerations of the technical and economical nature will have certainly a major impact and probably set the stage for the Lebanese government for the development of this universally acknowledged commodity, the natural gas for our electricity generation. Part of the strategic decisions by MEW or in the future by the market players is the move to the most effective way to provide new generating capacity with significant improvement in efficiency (Zahrani II, Jieh, Zouk etc..) is to build CCGTS, due of their relatively low capital investment and reduced construction time. Part of MEW policy is also to prepare Lebanon's utility or companies, when they are established to face after the market liberalization, to face energy international or regional competition. This is of course by keeping in mind that the CCGTS will provide a hedge against environment regulations. The following exercises will demonstrate the economical savings, the Lebanese treasury will certainly achieve.

Furthermore, electricity as the most important sector from an energy perspective, is necessary for all the sectors of the Lebanese economy, will be growing faster than any other final energy fuels in the near and short term future. Therefore, assuming that the total energy production is shared between steam power plants and combined cycle power plants respectively at 44% and 56%, the current situation could be as follows: The energy necessary for the operation of the power plants mentioned earlier is +/- 2,300,000 T.O.E. equivalent or in Natural Gas equivalent +/- 9,000,000 CM/day or 2 million tons per year of LNG , equivalent to 103,635,138 MMBTU .

Considering the above calculation and having as coefficient 1 Kcal equal to 3.98 BTU in energy production, you will see from the tables attached (Attachment II, pages 11 to 15) the difference if EDL acquires 1.5MM to 3MM CM/day of Natural Gas from the Syrian Petroleum Company as a first initial stage, and the remaining 2/3rd we either negotiate with our Syrian counterparts to import more from them (if they have the capacity of exporting the whole amount to us). The Government as well as EDL' s Management seeking to ensure the security of supply to support on growing demands, might want to consider buying Natural Gas from another source i.e. Egypt, Abu Dhabi, Qatar; Oman, Nigeria etc. in the form of piped gas or LNG. With regard to LNG, the mid 90's confirmed that the development of LNG trade has a bigger future and is to the Lebanese government's advantage; prices between LNG producers is stiffening. Therefore, the economical/financial advantages Lebanon would have, irrespective of the US$/Brent scenarios and the mode of delivery, could vary from US$MM 68/year to US$ MM 248/year. In this following chart your will be able to analyze the benefits/savings using several scenarios as described here below:

You will find for more details on how these evaluations were conducted in the charts pages 9 to 12 of this paper. Apart from the market circumstances that are accompanied by sectorial changes in this industry, the figures shown above aim in proving the price reduction for the generator and consumer, and for greater efficiency.

Table 1: Savings in Using Natural Gas vs Fuel Oil and Gas Oil

	Scenario 1	Scenario 2	Scenario 3
	US $	US $	US $
Case A			
Brent 15 $/bbl	38,665,333	68,800,000	23,598,000
Brent 18 $/bbl	61,153,333	80,104,000	51,678,000
Brent 20 $/bbl	73,477,333	86,836,000	66,798,000
Brent 26 $/bbl	98,732,000	97,800,000	99,198,000
Case B			
Brent 15 $/bbl	57,998,000	103,200,000	35,397,000
Brent 18 $/bbl	91,730,000	120,156,000	77,517,000
Brent 20 $/bbl	110,216,000	130,254,000	100,197,000
Brent 26 $/bbl	148,098,000	146,700,000	148,797,000
Case C			
Brent 15 $/bbl	96,663,333	172,000,000	58,995,000
Brent 18 $/bbl	152,883,333	200,260,000	129,195,000
Brent 20 $/bbl	183,693,333	217,090,000	166,995,000
Brent 26 $/bbl	246,830,000	244,500,000	247,995,000

Case A: **Beddawi + Zahrani = CCGT, Hraycheh + Jieh + Zouk = Steam Turbine**

Case B: Beddawi + Zahrani + Jieh (2005) =CCGT, Hraycheh + Zouk = Steam Turbine

Case C: All Power Plants (2012) = CCGT

Scenario 1: Using Natural Gas, 1/3 supply from Syria and 2/3 by LNG

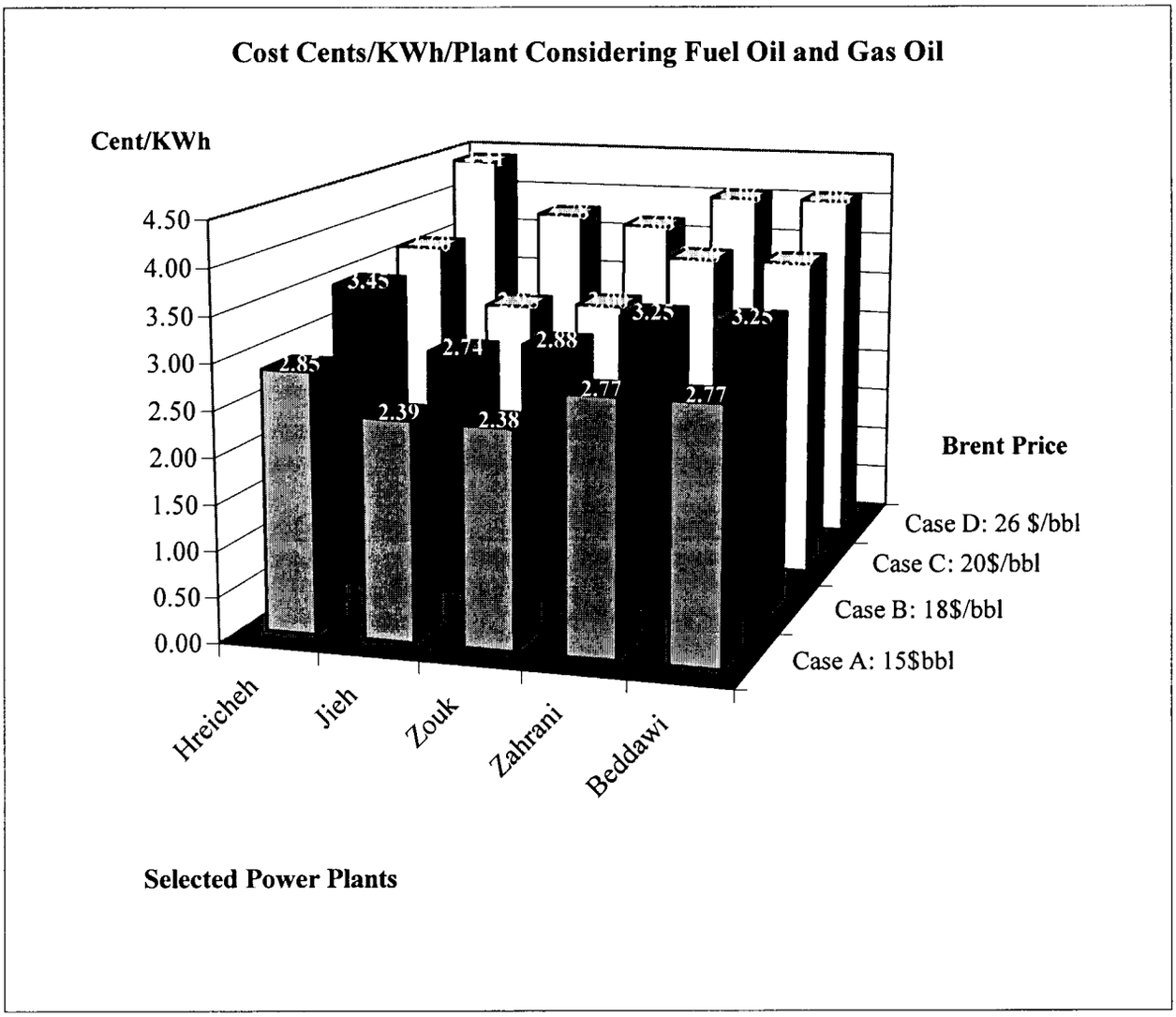
Scenario 2: Using Natural Gas, complete supply from Syria

Scenario 3: Using Natural Gas, complete supply by LNG

Effect(s) of FuelOil and GasOil Cost on KWh Cost (Actual Situation)

With the energy competition intensifying and our government's need for attractive contract(s) terms, we have to be remarkably successful in playing crucial role in supplying gas to our market. Now for the purpose of our kilowatt/hour cost for the existing power plants, a detailed description of the Jieh, Zouk, Hreicheh, Zahrani and Beddawi plants are outlined here below in Figure 1.

Figure 1: Cost per KWh per Plant - Actual Situation



The analysis conducted in the above-mentioned scenarios, draws that the average cost of electricity production (considering FO and GO) is 4 cents per KWh while the cost of total electricity production* is estimated to be 6.67 cent per KWh (average EDL Tariff of electricity sold is 8 cents per KWh). Thus the fuel cost contributes to 45-60% of the cost. (Kindly refer to attachments for detailed calculations) – pages 25 & 26

The next section discusses the methodology adopted in the implementation of natural gas use scenarios within Lebanon. This methodological section is necessary because of the many complex concepts and issues involved in such an implementation. Chapters II to V are one of the main sections of this paper. They introduce the several main scenarios and options analyzed and present to the reader the aggregate energy system results by fuel for Lebanon in order to give most of the priorities that will have to take place. The chapters also discuss the economic implementations that could result from the natural gas imposition.

* "A Case Study on Lebanese Electric Power System-Proposed Restructuring & Privatization Program-The Potential Benefits to the Lebanon" May, 2001

Figure 2: World Natural Gas Consumption in Power Generation (1996/2010)*

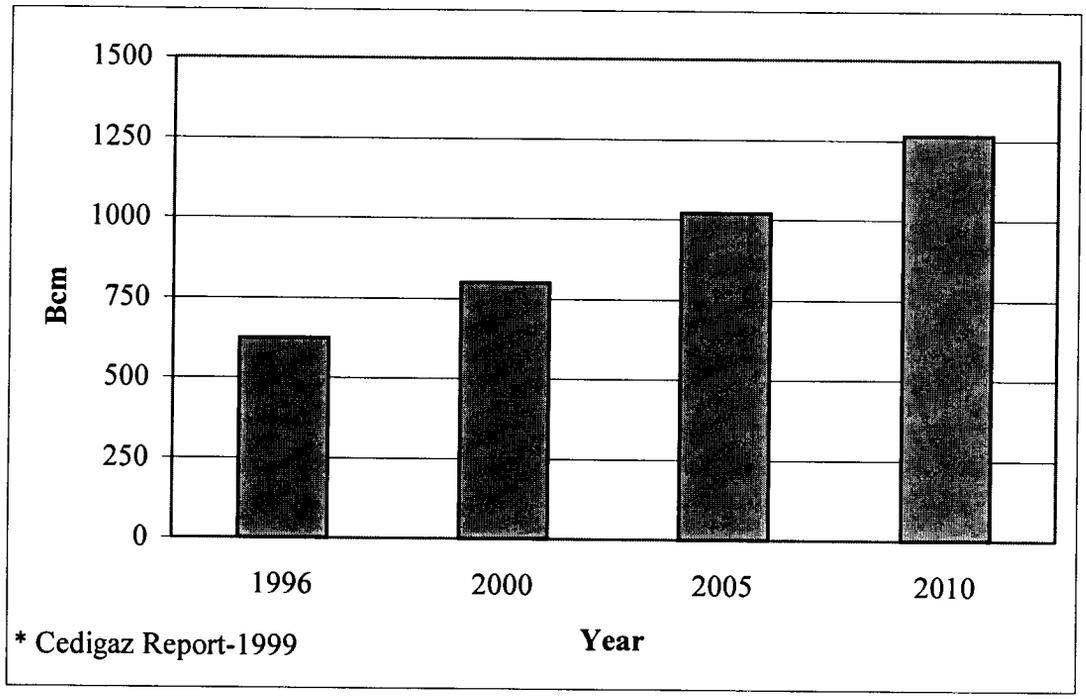
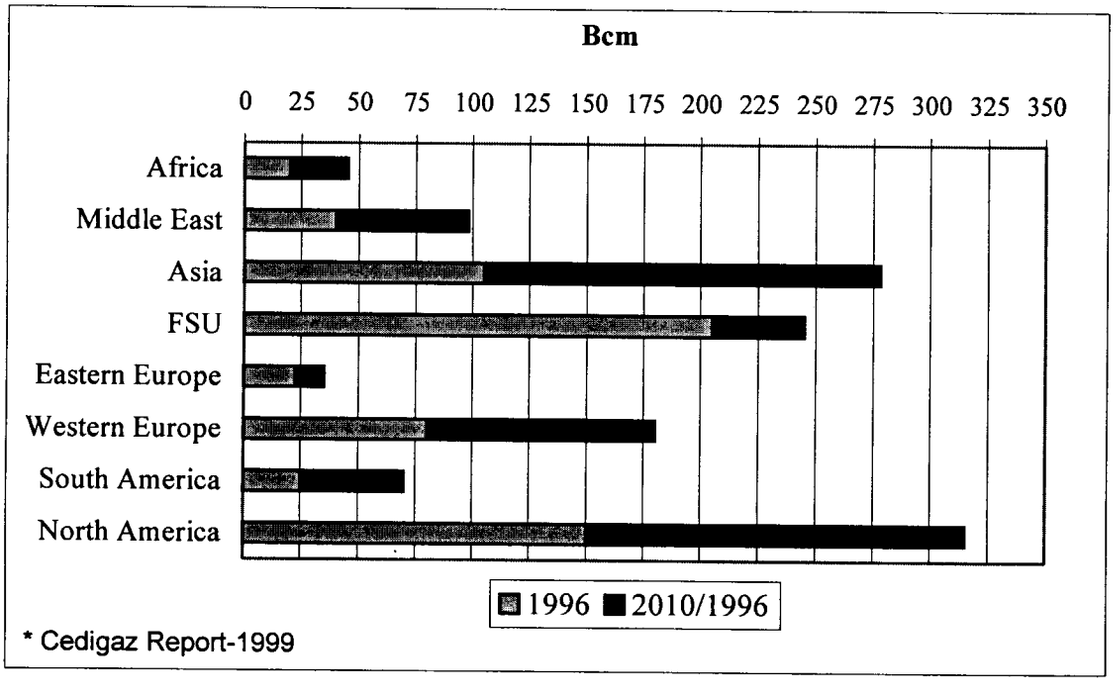


Figure 3: Natural Gas Consumption in Power Generation by Zone in 1996 & 2010*



II. MEDIUM/LONG-TERM STRATEGY FOR GAS – NATURAL GAS FOR ELECTRICITY SUSTAINABLE ENERGY DEVELOPMENT

The natural gas market in Europe, in the USA became the target of radical liberalization. Natural gas prices were liberalized, entry to the market was deregulated, and more importantly pipeline transportation was unbundled from the natural gas sales. These recent measures in the industry created a competitive wholesale market. In pipeline transportation (national and international),, economic regulation has gradually moved away from direct price setting to price flexibility, to allow private pipeline companies to adjust more readily to changing petroleum index market conditions. Deregulation has greatly benefited the participants in Europe and the USA natural gas industry.

This chapter examines the development and functioning of natural gas and possible gas transportation markets in Lebanon. In page 21 you will find a chart showing the percentage increase of natural gas development in 30 years, the percentages increased by roughly 31% over three decades. It first provides an overview of the private sector involvement to assist GOL in developing this important industry. It then identifies mechanisms that pipeline companies or operators need from the industry/MEW in order to avoid heavy regulation to ease the transportation and distribution market.

Highlighting the complex and multi-faced effect of growing competition as mentioned earlier, and globalization brings us here to the growing need of Private Sector involvement in Lebanon's Natural Gas Industry. The costs of energy projects are big. In the Lebanese case, serious financial resources are needed up front. Lenders, project promoters (Private sector) may be willing to accept certain risks while other interested parties might have to participate in an amount of equity participation of the project(s).

Here we come to the Private Sector Participation that would be introduced after the expected energy reform and the setting up of the Regulator, private energy companies would need to see a clear energy policy and a modern legal and regulatory framework in place in Lebanon.

The energy companies along with the MEW would be responsible for the planning and financing of capital intensive investments as well as the management and the operations of the oil and gas facilities and the IPP's.

Financing these type of mega projects is a wide and complex subject and many of its concepts are constantly changing. The innovation required to secure project financing, the competitiveness of tenders for projects, the increasingly international make-up of project consortia, all give rise to complex legal problems. Furthermore, the continuing liberalization of world energy markets magnifies the complexity as an increasing number of participants in the market seek new ways to exploit market opportunities.

The overall economic benefit of the Lebanese Natural Gas introduction project can be estimated in advance, as indicated in chapter 3. Beyond this, however, the Government must decide how much of the benefit will go to the treasury and how much will represent incentive and remuneration for private sector, local and or foreign capital. Although a profitable scenario is of course an important basis for attracting private sector investment, it may be equally important to create a realistic expectation of the benefits for the population. This can help "sell" the legislator and the population on the project as well, but it may also be helpful to have a clear notion of the Government's potential gain in order to prevent spending by the state that is not covered by revenue. This may be a particular issue for the natural gas, where a common public misconception is that as much revenue can result from gas as from oil products (in case of the refineries), which neglects the much higher transportation, distribution, and marketing costs of gas compared with oil.

Lebanon will gain revenues from taxes and levies on the gas but it can also benefit broadly from the involvement of domestic enterprises and individuals in the overall gas chain. Such involvement could include local banks financing parts of the project chain. It could also include local entrepreneurs developing

small gas distribution and employment generated by construction. The gas might also come into use in smaller industry (because of its handling advantages, even if it might on a per energy basis not be cheaper than substitutes). Yet another benefit comes from training of a work force in skills relating to gas applications. Clearly, a good gas policy can define a framework that maximizes the positive effects for the Lebanon beyond the pure revenue.

An important positive effect of the introduction of natural gas is the reduction of pollution from burning the several kinds of fuels. The global gas strategy based on public policy should also maximize the benefits of pollution reduction by suitable legislation.

In this chapter, you will notice the main items that would definitely concern the private sector view in this industry, highlighting mainly:

A- CREATING AN ATTRACTIVE FRAMEWORK FOR PRIVATE PARTICIPATION

MEW will expect a positive revenue contribution. Because of the positive impact on pollution, Lebanon should see if it can get the natural gas projects going, having due regard to the protection of the citizens. The investors and operators will be most concerned to have a stable framework and a positive economical environment, especially predictable rules on taxation and other government revenue in order to boost international investments and have a positive impact on Lebanon's financial risk if any. In the end, a participant should be free to realize a profit and to repatriate capital, which implies that the investor in Lebanon can always transfer revenues into hard currency.

With the expected new hydrocarbon law, apart from the Council of Ministers # 7929 dated 27/5/2002 concerning the Refineries and another proposed BOO/BOT Law for the LNG Terminal it will define and set up the sector structure and administering it, and possibly even participating, MEW and the Government will distinguish clearly between its different functions.

In this case special considerations may apply for the development of small gas schemes in the sense that these may be left largely or entirely to international or local entrepreneurs. To some extent for gas schemes the role of the state is much more clearly defined as thru the Regulator of the system, (like i.e. (OFGAS) U.K. Office of Gas Supply, when British gas was privatized in December 1986 now under OFFER (OFGEM) in England) although small gas projects also need good governance to keep their operation in line with reasonable technical and economic standards.

In the Lebanese case, the Energy Regulator has not only to determine the prices for the gas but has also allocated volumes to different consumers. One of the benefits of introducing gas is in providing choice to Lebanese consumers. If consumers are not attracted to gas by its price and quality, it is of no use to force them to use it. If the demand is higher than the volumes available, then the choice should be left to those who are able to offer the best prices or otherwise the best conditions whilst protecting the environment.

Also gas prices are best left to agreement between the market participants. In view of the natural monopoly character that gas transportation very often has and gas distribution practically always has, some form of regulation of the transportation and distribution tariffs will be adequate. The same applies for the tariffs to other end-consumers, i.e. ceramic and cement industries, who need protection against abuse of dominant market positions. Such economic regulation is best provided by the independent regulatory outfit that can assure all market participants of fair treatment.

GOL/MEW are very interested in planning for subsidies for the poor which are better given directly and only to them. Such subsidies will be typically provided by the Government for gas in temperate-zone countries so that no one freezes in winter. Subsidies can be provided explicitly via the distribution company billing system, particularly if the concern is that direct cash subsidies will be misused. The same applies to subsidies to certain industries.

A taxation system for an emerging gas industry should be designed to give incentives to reinvest into the country. Energy taxes are widely used to raise income for the state. One argument is that taxation of energy gives an incentive for its efficient use. If the consumption of energy is to be taxed, then the taxation should ensure that gas is not disfavored by a higher tax compared with the competing fuels. Policymakers might consider the environmental effects of various fuels by applying different taxation levels inline with the fuels' environmental impacts (thereby internalizing externalities).

In any case tax and incentive schemes for gas should be carefully thought out. If poorly designed, they can prove a stumbling block for otherwise economic gas projects.

B - ENSURING THE STABILITY OF THE GAS CHAIN

The gas chain includes a series of crucial links to the final paying end consumer: production – transport – distribution – power generation-transport of power- distribution of power- final use of power. The main challenge is to ensure the stability of the chain from the production point to the end user. In this context, stability means not only technical stability from the wellhead to the final consumer but also the stability of the cash flow and the commercial conditions. That is, investors must have enough incentives to invest and to stay satisfied with their investment over the project's lifetime; at the same time, the commercial arrangements must keep the consumers happy, or they will not use or pay for the service. The following are two essential conditions for a stable gas chain:

Contract law : This is necessary to enforce all kind of contracts MEW intends to have and defining the consequences of non fulfillment of contracts (e.g. to stop service after warning, as soon as a certain amount of arrears have accumulated). This is of special importance for gas downstream, given the long chains of transaction, which must not be interrupted, if the whole system is to work. In the sale of gas, contracts of sale and purchase of gas used to be made for a long time, often on a depletion basis. That means all the gas is dedicated to a single buyer.

The contract, which is usually lengthy document containing terms on the quality, quantity point of delivery, price with an escalation mechanism, taxes, assignment etc.

Here, you would find three types of contracts;

1. **Depletion and supply contracts**: as mentioned earlier, where the gas produced in a field is dedicated exclusively to a certain buyer, the contract of sale is called "depletion". The seller in fact dedicates the whole of Economically Recoverable Reserves (EER) of the field to the buyer. The quantities of gas to be delivered to the buyer each day is determined during a period know as the "plateau period". The depletion sale contract is usually made for a fixed period. However, the seller may be given the right to terminate the contract when the production of gas from the reservoir becomes uneconomical. The term "uneconomical" is strictly interpreted and it takes into account the depreciation on capital expenditure and not the saving costs to the producer or seller. Furthermore, the seller must give notice before stopping delivery of the gas to avoid any sudden interruption to the buyer's commitments.

2. **Under the Supply Contract**, the seller undertakes to supply a quantity of gas during a period of time without any reference to a specific field. There is no declining period in such a contract as the quantity will be the same. Gas from one or different fields may be delivered to several buyers.

3. **Long Term Contracts:** Gas long term contracts offer a security for the supply. But there is a need to ensure that the price of gas is competitive. This could be achieved by adopting flexible take-or-pay terms with a possibility of partial payment for un-lifted volumes, or an extension of lifting periods.

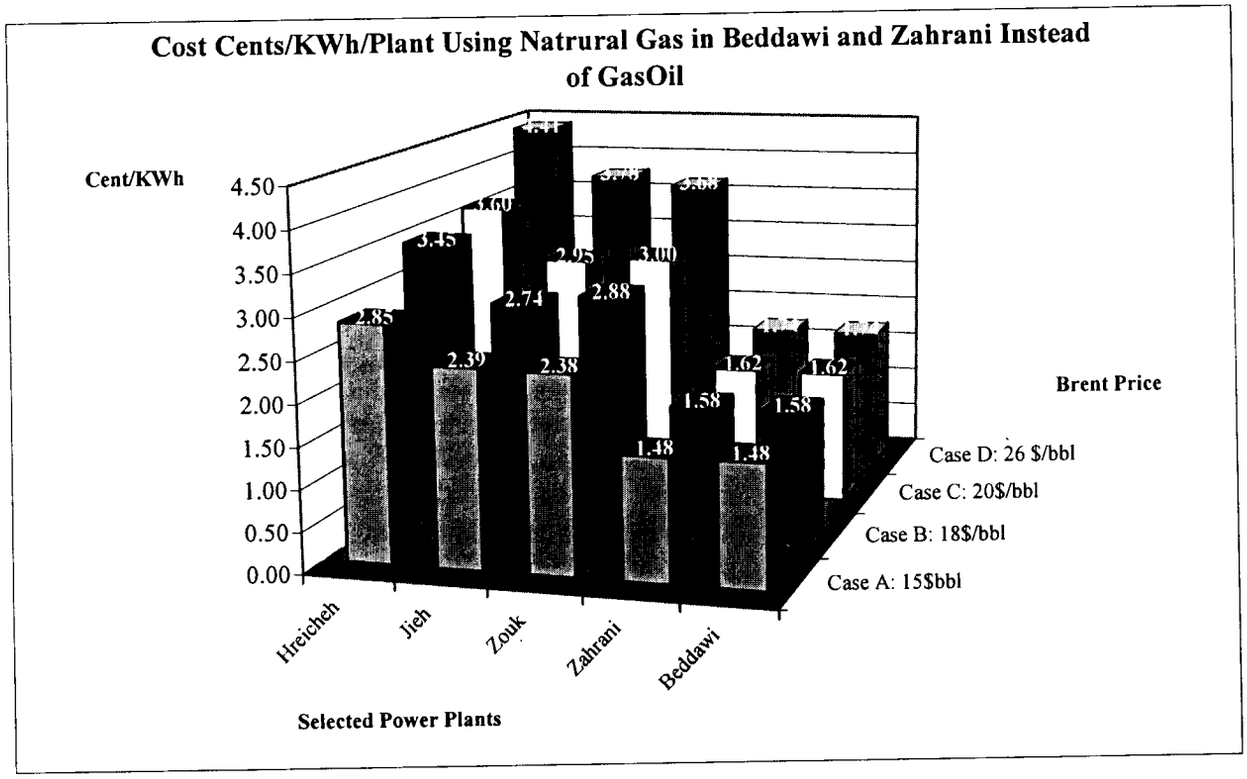
In this contract type, the following terms will have to be considered:

- The quality of gas;
- The quantities;
- Measurements and tests;
- Title and risk;
- Failure to supply or to take the gas;
- The price;
- Force majeure; and
- Arbitration and alternative dispute resolution

III. ACTUAL COSTS/GENERATION/ CCGTS FOR NEW POWER PLANTS

Till the eighties, with the exception of the USA and the soviet union (CIS) and some gas producing countries, natural gas was not used in electricity generation as it is now. With the development of the gas market, characterized by new regulation and more openness, with more environmental restrictions, the emergence of independent power producers (IPP) (as it is stipulated in the new Lebanese Electricity law) and with CCGT technologies (ie Zahrani and Beddawi), gas is moving and advancing in a spectacular way in electricity generation. The shift to gas could also be attributed to the decline of the natural gas production costs compared to crude costs in recent years, and for the oil and gas companies, the profit margin on the natural gas difference has increased in profitability in the upstream and downstream cases of natural gas. The current restructuring process of the Lebanese energy sector will be operating under a different concept with different incentives leading to new policy requirements and private investments in the context of high demand growth.

Figure 2: Cost Cents/KWh/Plant Using Natural Gas in Beddawi and Zahrani Instead of Gas Oil



All of these factors will be contributing to the growth of the Lebanese energy and the gas consumption in the electricity generation, industrial use and city gas. Figure 5, page 34 will demonstrate a partial benefit the gas would offer in the generation equation. By shifting to natural gas we can notice that the fuel cost (for the case of Beddawi and Zahrani) will have a smaller effect on the electricity production cost (as compared to Figure 1) (Kindly refer to Attachment IV, pages 27/28 for detailed calculations). Furthermore, gas has been more considered in the OECD countries as the rising prices of other fossil fuels consequently led to a major cut in the share of FO and GO in power generation and led to the use of gas in the producing regions.

The formula used in calculating the cost per KWh per power plant is:

$$\$/KWh = \frac{\text{Total Cost of Fuel per Power Plant}}{\text{Total KWh produced per Power Plant}}$$

Here we can notice in pages 10-13, the difference in the selected Brent prices, and the several differences in energy behavior, Lebanon should finalize its gas policy. The reader will notice here from the different scenarios that have been chosen are in order to adequately span the range of different estimates.

For each scenario, values of key variables are specified and the consequent electricity bill evaluated. Other Middle Eastern countries, who have vast oil and gas resources, have expensed constructing pipelines networks as they are assuring of large demand for their power and petrochemical sector and of proven reserves; such as, Algeria, Oman, UAE, Qatar, Saudi Arabia, Syria and Egypt, are opting for gas utilization in the power generation for maximizing crude exports and other mentioned benefits.

The outlook for gas consumption in power generation simultaneously incorporated the economical and environmental benefits on the combined cycle plants over the conventional plants. The analysis carried out is for the purposes of MEW/EDL projections here taken into account the dependence of capital costs and the performance in the size of the new power plants. However, we have to note here that there will be additional costs for the economic agents arising from the higher costs of the rise in transmission and distribution costs through out the projected period. This is of course would be passed on to the forthcoming private sector venture when the Lebanese energy market will be liberalized and the concern would be to improve the electric quality of the electricity supply to the Lebanese consumers.

On the worldwide scale, according to gas experts, world gas consumption for electricity generation could double by 2010.

IV. GAS DEMAND ORIENTED FROM SYRIA AND OTHER PRODUCING COUNTRIES

The Natural Gas nowadays has a sound and solid reliability record as a supplying and safe commodity in the world. World Natural Gas reserves have risen steadily over the last 20 – 30 years. Lebanon today has several opportunities to import natural gas. The first choice is to implement the M.O.U. signed between MEW & S.P.C. in 2001 to implement GASYLE I project and move forward with other schemes.

Pipeline Transmission & Distribution System

Natural gas is generally transported by pipeline in its gaseous state to final customers. In some countries, long distance transport of natural gas by pipeline is technical feasible and economical. Gas Transmission and distribution through pipelines in the developed nations has been a natural monopoly due to the high capital investment required and the economies of scale in the industry. The transmission of gas from the production site(s) to the Lebanese Power Plant could either be treated as a separate activity by an independent pipeline company (IPC) or carried out by the same upstream Private Sector investor. While the

concept of a IPC for transmission of gas is relatively new to developing countries, most gas in the US and Europe is being transited through a third party. The advantages of an IPC compared to the gas transportation done by the producers is that it provides a source of government income through pipeline transit taxes as well it creates a leveled playing field for all parties without too much control of the chain to one particular investor. Where the transportation is separated from the upstream activity, the government will have to create the necessary regulatory and legal environment to ensure undisrupted gas distribution and unfair pricing.

The IPC or MEW would serve as an intermediate transmission company which purchases gas from the seller/producer and resells to the power plant on the new IPP or the generation company. The transportation tariffs may be negotiated and included in the agreement along with quantities, and other requirements of pressure, quality and temperature.

When it comes to long distance transport across seas or oceans and/or mountainous terrain it could not be feasible. Expected progress in pipeline and LNG facilities, technology, reducing the costs of moving natural gas is enhancing its competitiveness.

The Russian/European and the Canadian to the U.S., enormous distance pipeline have been economical for the last 30 years as it serves a large gas market. The investment in both was very much needed and till today they represent the leadership in pipeline gas trade. More recently the United Kingdom Inter-connector pipeline and the Norwegian pipelines have also expanded the Natural Gas market potential. Some other producing country used their natural gas resources for their domestic needs and any surpluses they either transported by pipeline or by marine transport through the form of liquefied natural gas (LNG), for example; Malaysia, Indonesia, Oman, Australia, Algeria, Abu Dhabi, Libya has developed in the past LNG export facilities. In this respect the study will outline the basics of LNG Industry.

International experience in Europe and the Americas in gas pipeline cases has proven reliable even when they face political tension. In this study, the report has considered as it has been discussed in the recent Ministerial regional meetings, that a well-developed two way pipeline transmission system is needed for the Lebanese industry's gasification plan. The GASYLE pipeline project (pages 35 & 45) (a commercial pipeline enterprise) (Section I & II) (20"-24") direct cost, without cost of finance changes is estimated at US$ 160 MM in order to transport +/- 9,000,000 CM/day and deliver gas to all the coastal Power Plants. This will assure Lebanon to have a pipeline and distribution network to give comfort for oil and gas companies that are planning to invest in the future in exploring and developing gas reserves (if found) since the market is showing some potential availability. Because of the demographical factors, the GASYLE project will enhance the economic and commercial activity between Syria and Lebanon.

The Gasyle pipeline, and its two phases would connect the proposed block valve station in the Syrian Gas Pipeline Network with the following power plant: Beddawi in the North, Hreicheh in the north, Zouk near the city of Jounieh , Jieh and Zahrani south of Beirut.

Since MEW has defined the natural gas demand, typical data of power plant efficiencies and capacity factors have been taken into the design and engineering of the project. It has been also assumed that large potential industrial and residential clients will be served if close to the pipeline proposed routing. The overall long term annual gas demand has been estimated equal to approximately 4.0 billion cm/ year, of which approximately 93% is for power plants, 4% for the residential area of Beirut and the rest for industrial use. Considering the significant seasonal variations of power demand, a rather low usage factor of the gas transport pipeline (average annual flow-rate equal to approximately 62% of peak flow rate) would result.

A preliminary environmental impact evaluation has shown that the pipeline impact would be really minor and practically limited to the construction period. In a different study it showed that the overall seismic and geological scenario does not pose any significant threat to the pipeline operation nor is it expected to have a significant effect on construction costs.

In term of construction schedule, the two alternatives are equivalent; assuming as the starting date the receipt from the authority of the permit to build and operate the facility and assuming that the basic pipeline design has already been performed, the total construction and commissioning time is approximately 24 months for both options.

In terms of safety impact on existing infrastructures, limits and restraints on the land use and minimization of work uncertainties, the offshore option is by far the best one.

For the onshore (from Homs to Beddawi) and then offshore options, the landfalls have been limited to the power plants considering that potential industrial and large residential customers could be served through secondary pipelines originating from power plants sites.

For the offshore option, Lebanon has the right under International Law to lay an offshore pipeline on the seabed of Lebanon high seas, after the Homs grid Beddawi trench. Two options have been considered: Shallow water pipeline, which could run at an average depth of approximately 50-100m and deep water pipeline, which would run at an approximately 300-600m of average depth. The second option can be considered as a higher limit for offshore pipeline cost and has the advantage that the pipeline would be more protected from accidental external impact.

In fact the off-shore piping is inherently safe being quite far from any populated areas except at the few landfalls; further, this technology is now quite known (the first off-shore pipelines have been laid in 1944) and there are so many applications world-wide that the reliability of the system is assured, provided the installation is done by a specialized Company. Taking into account that the operations by the lay barge are performed in a quite controlled environment, according to very stringent quality control procedures and involve standard sequence of activities, it can be said that the final quality of the works is expected to be equal or superior to the option of on-shore routing.

For the arithmetic side, and the purpose of this simulation an average of 0.20 $/MMBtu over 20 years for the piping cost of Natural Gas to the Power Plants have been used.

In this empirical study, the various analysis have been limited to the Syrian Gas flow and LNG pre-proposals already available to MEW, due to the absence of the Egyptian gas cost charges and the routing of the pipeline from the offshore Nile Delta and/or the Western Desert (Refer to map on page 35). Also it is important to know that in the medium term the East Mediterranean region will become an attractive market for the Middle East gas. In a decade or less, transit routes will be crossing the area and it will become a natural-gas bridge across the Euro-Mediterranean countries. Therefore this report did not include the Egyptian scenario and detail the potential transit routes for this potential market(s). However, a free and transparent gas pipeline market must be created soon in the region (ie: Gulf-Egypt-Levant Networks) as is the case now for the electricity grid connecting several Arab countries to Turkey and later on to the Balkan Countries-Europe.

However, with international lines, issues of jurisdiction, the applicable law and conflict of law may arise. Apart from the rules of International Law on the right of laying a pipeline, the relationship between the states concerned, is usually subject to an agreement. Such an agreement covers undertakings to ensure an efficient maintenance system including facilities for repairs, safe navigation and measures to prevent pollution.

You'll notice on page 35, the routing of the new pipeline emanating from the Egyptian city of Al Arish to West of mount Ram as the Egyptian 1st phase, and the 2nd phase to the city of Zarka north-east of Amman to feed the several planned and constructed power plants. In this case, when the selected operator is chosen, the operator decide to use a pipeline for the conveyance of gas, a great deal of research, negotiation and eventually contracts are concluded.

A survey concerning the route is carried out to collect data regarding wave heights and frequency, prevailing winds, currents, geological data and shipping movements. The methods of installation, the location of the line and its planned life are also analyzed. Where part of the line is to laid in a third country, it would be necessary to negotiate the right of crossing and all related issues with the country concerned. Further enquiries are necessary to secure the financial resources needed for the construction of the line, compressors, pumps, etc. So, in addition to the financial arrangements, a long term sale or supply of gas and the insurance cover, which are treated in other parts of this work are essential. These contracts are hotly disputed during the negotiations and are full of pitfalls. However, the main contracts are the:

i. operating agreement;
ii. construction contract;
iii. tariff; and
iv. service contract.

LNG – (Liquefied Natural Gas)

Recent market developments have shown that LNG can compete in mature, competitive markets such as North America and Europe, particularly at the extremities of piped transmission networks. In Europe, LNG is certainly proving to be a competitive alternative to piped natural gas and one which is attracting considerable interest as the fifteen member States of the European Union engage in the process of liberalizing their electricity and gas markets.

The LNG industry relied on technological developments in cryogenics of generating low temperatures. The use of LNG began in the United States for peak shaving in the early 1910's but the first international trade of LNG dates back from the mid-1960's when Algeria began exporting LNG to the U.K.. LNG trade accelerated in the mid-60's as several countries such as Abu Dhabi and Libya decided not to flare their natural gas, which was produced in conjunction with oil, as associated gas. Since the 60's, trade volume of LNG exports has risen substantially. The gas was a surplus to their domestic needs or those of the neighboring countries so it was advantageous for them to develop Mega LNG projects to transport LNG by specialized tankers to distant markets of gas consumption i.e. Japan, Korea, Europe and the U.S. The LNG Trend between 1997 – 2000 in inaugurating several LNG Plants and New Spot LNG Routes confirms that this industry is headed for greater expansion.

Here we can bring up to the reader 's attention the European example, that despite their proximity of large producing nations i.e., Russia, Norway, United Kingdom and the very well established pipeline system that transports gas, LNG is occupying a relatively important part of gas delivery (10 terminals in the Mediterranean region already), which showed a desire to diversify the importation of gas, start competing with prices and safeguard the security of supply.

LNG Ventures

In most LNG schemes, these ventures raise technical, economical and partnership issues that need to be studied at length. It is believed that LNG, with its proven dependability and guaranteed long-term supply capabilities, will capture a significant share of the power generating business in the Mediterranean areas where domestic fuels are scarce and pipeline gas availability till now is limited. It is also believed that LNG will find increasing use in the industrial and residential/commercial markets in the medium to long term planning.

It is important to remember that a successful LNG project involves a complex interaction of buyers and sellers, GOL, financing institutions, and shipping companies. LNG Projects are buyer/seller-specific, and facilities are commonly dedicated to a particular contract or sale. The partnerships formed to bring an LNG project together must be strong enough to travel the long, tedious road leading to project start-up.

However, the gas industry found that these partnerships, if successful, can last many years and be very fruitful to all parties involved.

Many of the potential grassroots re-gasification projects are in countries where, quite obviously, there is no experience with LNG. And Lebanon has limited financial capabilities. To make an LNG terminal project feasible, we must rely on several basic principles. First the energy company relationship with the host country Lebanon, requires a mutual understanding and commitment to every component of the LNG business chain. The goal is to maximize the value of gas. Concentrating on this key point yields the greatest economic benefits to the joint venture partners and Lebanon. And this means that the LNG plant and shipping are generally operated on a cost pass-through basis. Second, to both justify and protect the partners' and the hosts' investment, a long term sales contract with a floor price is required in which the LNG buyers share some of the project risk and bear the cost of the financing.

Finally, getting LNG to the terminal and the power plants requires a complex set of business arrangements, which extend from the gas reservoir to the power plant or industrial facility that burns the gas. The distance can cover thousands of miles. LNG is a business chain between seller and buyer that involves many activities and specialized single-purpose facilities. At the same time, an LNG plant and harbor facilities need to be constructed. MEW estimates that this would take 36 months from SPA. Ships must be ordered also. The receiving country will need a port and re-gasification facilities and pipelines to the end-users.

Criteria of LNG

The gas must first be converted from its gaseous state to liquefied natural gas. The gas from the field is transported in its gaseous state by pipeline to a liquefaction plant which is located on a coast. The gas is then liquefied by cooling it to minus 170° Celsius which reduces it to one six-hundredth of its original volume. This is accomplished by cooling the natural gas with a secondary refrigerant(s) and by pressure reduction of the natural gas. The very cold or cryogenic natural gas is called then, liquefied natural gas (LNG).

There are three main components in the carriage of LNG: the liquefaction plant, the gas carrier and the re-gasification installation. At the liquefaction plant two basic processes are under-taken: the purification of the gas and its liquefaction. Gas enters the plant and the unwanted gases in the predominantly methane mixture are removed.

The purified gas is refrigerated, leaving the plant at a temperature slightly below the liquefaction point. It will then either enter storage or is loaded into the LNG ships.

Liquefaction plants traditionally use sea water for cooling and steam turbines for power, but a newly developed liquefaction system using air cooling and gas turbines to drive the plant's refrigerant compressors.

LNG Transport

LNG is transported by sophisticated tankers which are specially designed to contain LNG. The older LNG ships are in the 25,000 – 65,000 cubic meter LNG range, but most of the newer ones are in the 125,000 cubic meter LNG class, measuring some 900 feet in length, which can carry a little under 3 Bcf in each load. Structural designs fall into two main categories; tankers with spherical self-supporting tanks of the Moss Rossenberg designs and tankers with integrated membrane tanks, of the Gaz Transport or Technigaz design. Generally, there are four to six separate insulated tanks in each ship. The tanks sit within the hull, forming an elaborate system of tanks, barriers, and linings which ensure protection from leaks or damage from possible collision. The boil-off or naturally occurring gradual vaporization of the LNG is used as fuel for the ship propulsion systems (turbines) of the ships; diesel oil is used as a backup fuel.

The LNG tanker's destination is the receiving terminal generally owned by the LNG customers or in the Lebanese case, by the private sector promoter, which ideally is located near the gas consumption center(s) i.e. Zahrani, Beddaoui or Zouk power plants, or close to a pipeline network(s). The terminal consists of berthing platforms, docks, storage tanks and re-gasification facilities. The re-gasification installations serve to raise the temperature of the LNG from below its boiling point of about -161°C to close to atmospheric temperature. The tanker's liquid cargo is pumped as LNG into insulated storage tanks. The LNG can be stored in tanks for extended periods during periods of excess gas availability. The LNG is then pumped at high pressure to the re-gasification facility where it is re-vaporized back to its gaseous state. The natural gas can then flow into the pipeline system to be combined with other gas supplies and to be utilized in the same as any other natural gas. The re-gasification terminals, of which there are about 60 worldwide.

While LNG is normally gasified before distribution, there are certain situations in which it is preferable to transport the gas still in liquefied form to outlying distribution centers. An example would be where the pipeline distance is too great or the clients are in different direction not serviced by pipeline from the re-gasification terminal. In these instances, the LNG is pumped into insulated containers in special road trucks and transported to local storage facilities for re-gasification. However, very small quantities are delivered in this manner.

The processing, storage and transport of LNG at all stages must be meticulously controlled because LNG possesses unique and potentially hazardous properties. The LNG industry has developed stringent safety standards in design, construction, maintenance and operation; these safety codes are strictly enforced.

LNG facilities are considered very safe relative to other energy industries. They can be sited safely near them; for example, the terminals in the Far East and Europe are located near other energy industry facilities. The same is true of the siting of liquefaction plants. However, in some instances, it may be desirable to provide for siting of the LNG facilities away from areas which pose inherent hazards and away from densely populated areas. Among the safety features incorporated into the liquefaction, loading, storage and re-gasification facilities are automatic shut-off valves which limit spills, primary and secondary systems of containment within the storage tanks and surrounding dikes, and extensive fire control and other safety systems. Special firefighting techniques have been developed including the use of foam or dry chemicals and water deluge systems or water screens to control fires.

LNG contracts require multi-billion dollar magnitude resources to develop, negotiate and finalize one. Multinational institutions, banks and lenders will be indispensable players at a certain time. LNG contracts various considerations are taken into account and in particular the return on capital investment, the political risks, the technical risks affecting the production, liquefaction and re-gasification and the development of the World gas market. As a result and as mentioned earlier, the contract of a LNG contract is made for a long term and requires an intensive deal of close cooperation between the parties involved. To sum up, the LNG project in Lebanon must have a manageable political and economical risk as the challenge would be to ensure the economies, technology and the appropriate partnership will be the success for long-term profitability and safeguard the economic return to GOL and its partner(s).

The motivation for natural gas here, whether through pipeline or LNG, is stemmed from a desire to see the development of a regional energy market across the Arab Mashreq, the Gulf States, encourage intra-Arab Electricity and Gas trade and stimulate the free movement of gas throughout the different countries and therefore encourage innovation in the field of energy supply and industrial/customer choice.

At the end a major milestone has always to be looked at is the ***"Gas Flow Control"***. MEW/GOL will always have to keep the following parameter in line with:

- ***Central Dispatch*** – central dispatch directs flows of natural gas through the pipeline system according to a predetermined flow schedule and an emergency plan.

- ***Operational flow orders*** – These are emergency orders issued by Pipeline Companies/Regulator that require shippers to inject or withdraw natural gas at a specific point to ensure continued flow of natural gas through the system.
- ***Curtailments*** – Under curtailments, pipeline may cut off transportation or storage service to shippers in the event of a major supply or capacity disruption.

The gas companies with the Regulator should have the ability to control all parameters mentioned above in order to maintain system balance in Lebanon's transmission, distribution and marketing the natural gas.

V. MEW/EDL BENEFITS

Savings Incurred by Other Elements than Fuel Cost Supply Policy development for promotion sustainable production and consumption has focused recently on economic instruments as mentioned in this paper and environmental taxes, all to be integrated in the Lebanese Regulatory.

This chapter starts by discussing the most important assumptions that will change this sector policy stance. The combined effects of the following factors (a,b,c,) gave use to the dash for gas in different countries specially when combined cycle power plants are in use. In several industrial applications in the world, natural gas is well suited for a number of operations and utilizations. Because of its particular physical and chemical properties, several advantages (as mentioned here below) would derive when using it. It's important also to mention that the heating value of natural gas is also more attractive i.e. the Conversion factors between the consumption of Natural Gas and Heavy Fuel Oil (FO) and Gas Oil (GO) considered here are based on the following respective Heating Values:

- Low Heating Value of Natural Gas = 11,970 Kcal/Kg
- Low Heating Value of FO = 10,035 Kcal/Kg
- Low heating Value of Diesel Oil = 10,350 Kcal/Kg

The fuel cost savings that is studied in pages 9-12, will be added to the several savings MEW/EDL will benefit from this change:

a. **O&M per power plant**, cost per year (see page 38 of this paper),
b. **Reducing certain capital items (CAPEX)** in the new Combined Cycle in Jieh in 2005 and in Zouk in 2012, and approximately every six years until the year 2020, (Kindly, refer to page 39 of this paper)
c. **Longer life cycle Span,** for every new or existing Power Plant running on Natural Gas will enjoy.

a) Operation and Maintenance (O& M)

The important item of savings is in the O & M part as tabled here in table 1:

Usually, large centralized generation power plants run a substantial number of costs associated to do with transmission and distribution, electrical losses, capital intensive, maintenance costs, security of supply and operational constraints. It can be argued that consuming natural gas should have some benefits from some of these costs.

The results of the analysis with the O&M part showed a major saving of +/- 10% of roughly $ 9,380,000 per year for all the considered Power Plants as of 1998.

Table 2: O & M Saving Per Power Plant

Power Plant	Generating Capacity (MW)	US $/ year	US $ / year / unit
Zouk 1-4	3x145	125,000	375,000
	1x170	125,000	125,000
Hreiche	1x70	95,000	95,000
Jieh	2 x 60	95,000	190,000
Jieh	3 x 65	95,000	285,000
Beddawi CC		4,155,000	4,155,000
Zahrani CC		4,155,000	4,155,000
TOTAL			9,380,000

In this particular exercise for the Combined Cycle Power Plant i.e. Zahrani and Beddawi, and the new ones later, you have to consider that the reduction in above cost is made up from 2 major elements:

Saving in spare parts saving in de-mineralized water to be injected in the gas turbine when burning gas oil (to enable the O & M staff to control the NOx emissions and others)

b) Major Capital Investment Savings (CAPEX)

The second important saving item comes with the building of a new Power Plant in 2004-2005 when the Jieh Plant is declassified by that time, and building another CCGT in 2014 and a third Power Plant in Batroun or Zahrani extension (2012), we have considered in this report the reduction of certain major capital items that are no longer needed by using Natural Gas rather than gas oil in the new CCGTs plants.

The following are the most important capital items to be deleted when MEW/ the private sector (IPP) will be engineering new CCGT plants:

Reduction in Major Capital Items by using Natural Gas rather than Fuel/Gasoil in future Power Plants (Jieh, Batroun, etc..)

Delete 2 x 25.000 CM in the Tank Farm
Delete 2 x 2000 CM in the Tank Farm
Reduction to 50% of the capacity for desalination plant
Reduction to 50% of the capacity for demi plant
Deletion of Nox injection system
Deletion of fuel oil treatment
Deletion of sea line and mooring
Reduction to 50% of fire fighting
Reduction of 20% of civil work
Reduction of AUX systems (minus 20% of the facilities)
Reduction to 40% of the AUX boiler
Reduction to 50% of oily waste
Reduction to 50% of the demi tanks

The rough estimates calculated for the above was considered with the deletion of the previous items amount to an approximate sum of $MM 33 per New Combined Cycle Power Plant. (CCGT)

c) Longer Cycle Span Per Power Plant

As the outlook deals with long-run gas trends, it is generally assumed that there are other few cases in which the beneficial analysis applies when the preference for the use of new energy forms like natural gas

is used. This item we have to calculate in this study, is to consider the life cycle per Power Plant, once we switch to natural gas. According to industry sources, the life cycle will extend by at least 5 years per Power plant ; so if we consider the saving of 5 years we will have an average of savings/year/Plant

Assumptions of the life span of the two CCGT plants together with the age structure of the existing steam plants i.e. Zouk, Jieh, Hraicheh, determine the schedule of the Lebanese power plant retirement. The assumed retirement schedules that have been followed in this report are gathered from MEW/EDL sources for the plants.

It is worth mentioning that the retrofitting of existing power plants, such as Zouk in order to burn natural gas (assistance already offered by the Italian Government) will lead to a lifetime extension of 5-7 years. The schedule of investments has not been formulated in the capital investment exercise. The energy use will be dramatically different from the business environment within which the electricity industry was produced in the recent past. Two of the most important determinants factor of the gas change are likely to be the continued move towards a market of electricity grid of Egypt, Jordan, Iraq, Syria, Turkey and Lebanon (EJITSL) and parallel to that the shift to more competitive markets ever the six member states. Consequently, with the Lebanese natural electricity market, the scope for more competition at least in the generation (as studied in this paper) will increase significantly with it's proposed unbundling.

$$\frac{\$MM\ 265 - 265}{\text{Years}\ \ 20 - 25} = \$MM\ 2.65 \text{ per Power Plant}$$

We can consider this to apply on the Zahrani Power Plant, Beddaoui Power Plant, the new Jieh Combined Cycle Power Plant 2004-2005, the new Zahrani extension (Zahrani II) or Batroun for the years 2012/2014 (if Zouk power plant is de-classified) and all new Plants coming up therefore.

CONCLUSION

The key conclusions by implementing the gas option would be mainly in:

- The introduction of competition into the Lebanese electricity markets can deliver real benefits in terms of sustainable development mainly in cost efficiency, downward pressure on prices and customer care;
- It is necessary for MEW to undertake before the natural gas operations a rigorous cost-benefit of intended market measures to ensure that benefits are commensurate with actual and the foreseen costs;
- The competitive potential of each stage of the electricity chain including the six countries EJSITL connection should be examined when finalizing the design of the Lebanese market, not just electricity generation, as in some cases the electricity transmission results more convenient for longer distances of gas fields from electricity consumption area;
- Market modifications will be needed to achieve social and national goals;
- If competition in generation is appropriate, separate dispatch from pricing, so that longer-time frames may be used for pricing with natural gas, with benefits in terms of reduced cost and increased competitive pressure;
- The current regulation of the energy market and the planned interstate with Syria pipeline and its secondary transportation will promote efficient allocation to sustainable development. Flexible pricing should be introduced later to promote the transportation and retail markets that is the most important challenge for our energy regulator.

List of Abbreviations & Acronyms

BOD	Board of Directors
BOO	Build Own Operate
BOT	Build Operate & Transfer
BOOT	Build Operate Own & Transfer
CEGB	Central Electricity Generating Board of U.K.
CCGT	Combined Cycle Gas Turbines
COM	Council of Ministers
EDF	Electricite de France
EDL	Electricite du Liban
ESCO	Energy Services Companies
FERC	Federal Energy Regulatory Commission – U.S.A.
GW	Gegawatt (1000 MW)
GWHR	Gegawatt Hour
GOL	The Government of Lebanon
HEC	Higher Energy Council
IFC	International Finance Corporation
IPP	Independent Power Producer
Kv	Kilovolt
KW/Kwhr	Kilowatt hour
LEPS	Lebanese Electricity Power Sector
LOT	Lease Operate Transfer
LSDP	Letter of Sector Development Policy
MEW	Ministry of Energy & Water
MM	Million = 10^6
MOF	Ministry of Finance
MOP	Ministry of Petroleum
MV/LV	Medium Voltage/Low Voltage
MW	Megawatt (1000 kW)
OFFER	Office of Electricity Regulation, U.K.
ONL	Office National du Litani
PPA	Power Purchase Agreement
RTO	Rehabilitate Transfer Operate
SPC	Syrian Petroleum Company
UNFCCC	United Nations framework Convention on Climate Change
WB	World Bank