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Republic of Lebanon
Hydrocarbon Strategy Study

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Abbreviations and Measures

BBC	Brown, Boveri & Co.
b/d	barrel(s) per day
BCM	billion cubic meters
BOOT	build-own-operate-transfer
CCGT	Combined Cycle Gas Turbine
CEPCO	Chubu Electric Power Company Ltd.
CIF	Cost, Insurance, and Freight
CO_2	Carbon Dioxide
EdL	Electricité du Liban
EIA	Environmental Impact Assessment
EMA	Energy Market Authority (Singapore)
EMG	Eastern Mediterranean Gas
FERC	Federal Energy Regulatory Commission
FSRU	Floating, Storage, and Regasification Unit
GDP	gross domestic product
G.E.	General Electric
GHG	green house gas
GJ	Gigajoul
g/kWh	grams per kilowatt hours
GNP	gross natural product
GWh	gigawatt hours
HFO	heavy fuel oil
IEA	International Energy Agency
IEC	Israel Electric Corporation
KBR	Kellogg, Brown, and Root
kWh	kilowatt hour
LNG	liquefied natural gas
LPG	liquefied petroleum gas
OFGEM	Office for Gas and Electricity Markets
mmbtu	million British thermal units
MMCM	million cubic meters
MEW	Ministry of Energy and Water
MW	megawatt
MWh	megawatt hours
NOC	Libyan National Oil Corporation
NOx	Nitrogen Oxides
NTPA	negotiated third-party access
O&M	operation and maintenance
PSC	Petroleum Syrian Company
PM10	particulate matter less than 10 microns
RTPA	regulated third-party access
s o x	Sulfur Oxides
TOR	Terms of Reference
TPP	thermal power plant
VAT	value added tax

Vice President:	Christiaan Poortman
Country Director:	Joseph Saba
Sector Director:	Emmanuel Forestier
Team Leader:	Anna Bjerde

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Contributors:
This report was written by Anna Bjerde and Franz Gerner with contributions from Chubu Electric Power Company Ltd. of Japan (CEPCO); Jay Park and Camille Saadé (Legal Aspects); Sam O'Brien-Kumi (Petroleum Market and Pricing Aspects) and Lizmara Kirchner. The report benefited from helpful comments from Bent Svensson and Bill Porter, peer reviewers.

Preface

The Republic of Lebanon has no proven fossil fuel resources. The lack of domestic energy sources and an increasing energy demand are major contributors to Lebanon's chronic trade and current account deficit. In 2002, Lebanon's trade deficit accounted for more than US$5.3 billion, or about 30 percent of annual gross domestic product (GDP) and the country's public debt stood at US$29.5 billion, equivalent to 170 percent of GDP.[1] In that year, the oil import bill reached about US$720 million, which is nearly 60 percent of the country's revenues from tourism and merchandise exports.

The Government of Lebanon recognizes the significant impact energy imports have on its fiscal position. To improve its public finances, the government has decided to introduce natural gas into the Lebanese energy market, initially targeting power generation. An increased usage of natural gas and a subsequent substitution of the relatively more expensive fuel, and gas oil is expected to have a positive impact on Lebanon's foreign exchange position, trade balance, and the financial viability of the electricity sector. The introduction of natural gas will also have positive effects on the environment and promote increased competition among various sources of energy for commercial and domestic usage.

The objective of this hydrocarbon strategy study is to assist the Government of Lebanon to formulate a comprehensive long-term strategy for the future development of the hydrocarbon industry in general and the introduction and utilization of natural gas in Lebanon in particular. This paper sets out a strategy that takes into account the gas potential demand, supply options, market structure to allow for efficient service delivery, and legal and regulatory framework to enable competition, and provides an overall assessment of the potential financial and environmental benefits of using gas. While the strategy focuses on the development of the natural gas market, it also assesses the impact from increased gas use on the demand for petroleum products, analyzes the current shortcomings in the petroleum market, and investigates whether Lebanon should consider investing in new refinery capacity.

This hydrocarbon strategy is based on several studies carried out by a consulting consortium led by Chubu Electric Power Company Ltd. (CEPCO), a Japanese utility and consultant, and an analysis carried out by the World Bank Team.[2] Local and international legal experts, partially funded by the Public and Private Infrastructure Advisory facility (PPIAF), provided legal assistance. The various studies and this hydrocarbon strategy have been developed in cooperation with a counterpart team within the Lebanese Ministry of Energy and Water (MEW). The Terms of Reference (TOR) for the study are attached as Annex 1.

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[1] Ministry of Finance. *Public Finance Prospects 2002—Ministry of Finance Yearly Report (January–December 2002).* Obtained at http://www.finance.gov.lb in October 2003.

[2] The work of the consultant was funded through the Japanese Trust Fund and managed by the World Bank.

Executive Summary

1. The Government of Lebanon has decided to introduce natural gas into the Lebanese energy market. To implement this decision, the government has entered into strategic discussions with its neighbor Syria for a bilateral project, and its neighboring countries Egypt, Jordan, and Syria on the potential for a regional gas pipeline project using Egyptian gas. These discussions have recently moved from debate to action, with the construction of a 32-kilometer pipeline from Syria to Northern Lebanon (called GASYLE) currently under way. GASYLE will transport up to 3 million cubic meters (MMCM) per day of Syrian gas under a 25-year contract at a price representing about two-thirds of the current fuel cost for power production.[3] In January 2003, an agreement between Lebanon, Jordan, Syria, and Egypt was signed declaring the four countries' intent to develop a regional gas pipeline going from Egypt to Lebanon. Construction of the first phase of the pipeline from Arish in Egypt to Aqaba (260 km) has been completed, project agreements on the second phase from Aqaba to Rehab in Amman (390 km) were signed in January 2004, and construction has recently started. Gas has started flowing from Arish to power plants around Aqaba, and the flow is estimated to eventually reach 10 billion cubic meters per year (BCM/year).

2. The initial market for gas in Lebanon will be small and consumption will be anchored in key power plants able to operate on gas. However, the potential demand for gas greatly exceeds the initial 3 MMCM available from Syria and potentially goes beyond consumers in the power sector. This raises several opportunities to create a dynamic, private sector-led, competitive market, but also challenges in the way of financial sustainability, security of supply and environmental and social mitigation. A comprehensive strategy is needed to ensure that the gas introduction leads to a sustainable market, which materializes the government's cost reduction objectives and environmental benefits. This paper sets out such a strategy. However, it has to be noted up-front that the critical factor for successful introduction of gas is a turnaround of the extremely fragile power sector given that gas consumption will be anchored in the power sector.

The Status of the Power Sector

3. The power sector in Lebanon is dominated by the national electric utility, Electricité du Liban (EdL), which is organized under the Ministry of Energy and Water (MEW). EdL's assets, human resources, and administrative facilities were severely damaged during the period of civil war in Lebanon, and most efforts in the post-war period have been on the rehabilitation of assets, with a lesser focus on strengthening the company from an institutional, administrative, and financial perspective. As a result, the company is characterized by lack of technical and managerial capacity, lack of systems to manage and monitor performance, and a weak financial situation, with close to US$400 million in deficit every year and a quickly deteriorating balance sheet (retained losses now exceed US$1 billion). At the operational level, losses, primarily nontechnical, are approaching 50 percent and continued transmission constraints and unreliable service have resulted in a surge in self-generation. Attempts to privatize EdL have failed because of the lack of financial performance required to attract investors. The government is very concerned about the fiscal drain EdL poses and is seeking options to improve the company's, and the sector's, performance.

4. **As an immediate priority, the Government of Lebanon should (a) put measures in place to improve the financial and operational performance of EdL (through, inter alia, the introduction of an interim Management Contract); and (b) in parallel, develop a long-term strategy for reforming**

[3] Up to 6 million cubic meters/day (MMCM/day) is provisioned in the contract with Syria but beyond 3 MMCM/day requires further negotiations.

and restructuring the sector with a view of increased level of private sector participation in the financing and operation of the sector and efficient competition.

Potential Gas Demand

5. The existence of the Bedawwi and Zahrani Combined Cycle Gas Turbines (CCGTs), conversion of other existing power plants to natural gas, and construction of new plants operating on gas to meet electricity demand could result in natural gas demand reaching 12.10 MMCM/day by 2020, with about 75 percent of the demand being accounted for by the power sector.

6. There is also potential for the industrial sector to utilize natural gas, in particular energy-intensive industries such as cement. Considering the limited potential for natural gas usage in the residential and commercial sectors, further analysis is required to assess the viability of a distribution network. A distribution network in a highly densely populated area, such as Beirut, may be financially viable.

Demand Forecasts for Natural Gas (MMCM/day)

	2005	2010	2015	2020
Residential	minimal	minimal	minimal	minimal
Commercial	minimal	minimal	minimal	minimal
Industrial	0.00	1.80	2.40	2.87
Power sector	2.02	8.07	8.55	9.23
Total	**2.02**	**9.87**	**10.95**	**12.10**

Note: MMCM/day = million cubic meters per day.
Source: Chubu Electric Power Company Ltd. (CEPCO) 2004.

7. **The Lebanese Government should (a) develop a least-cost conversion plan for existing thermal plants and analyze the construction of new gas-fired plants to meet future electricity demand; and (b) further investigate the viability of a distribution network to supply industrial, commercial and residential customers in large cities, including Beirut.**

Gas Supply Options

8. Lebanon is strategically located in a gas-rich region and is surrounded by several supply options, including both piped and liquefied natural gas (LNG).

9. There are currently three main alternative sources of piped natural gas for Lebanon: Syria, Egypt, and Iraq. In the short-term, the only viable source is from Syria, where the relevant pipeline connection is being constructed. In the medium-term, gas from Egypt may become a viable option for Lebanon once the Arab Gas Pipeline has been finalized. In the long-term, Lebanon, and indeed the whole Mediterranean region, will benefit from the rehabilitation and reconnection of the Iraqi gas network, allowing the region to tap into large Iraqi gas reserves. Furthermore, LNG potentially can be considered as a viable option to bring gas to Lebanon should the price of LNG continue to fall. Finally, although it is in the early stage, should the positive leads about offshore domestic gas and oil resources prove real, Lebanon could potentially achieve a certain level of self-sufficiency when it comes to gas sources.

10. **Considering the current contractual arrangements and the limited size of the Lebanese gas market, Lebanon should (a) follow a "phased" approach in constructing gas infrastructure that is closely aligned with gas demand growth to avoid over-investing; (b) pursue a piped gas strategy in the short- to medium-term that allows the country to maximize the benefits from utilizing gas imports from Syria under the current favorable contractual arrangements; (c) pursue regional interconnection with neighboring countries that enables the country to import gas from Egypt via the Arab Gas Pipeline; and (d) pursue the investigation of its own potential resources. Lebanon**

should only consider the introduction of LNG once domestic gas demand outgrows more economic gas supply options from neighboring countries/own sources.

11. **To ensure security of supply, Lebanon should maintain dual fuel capability of its power plants to mitigate the risk of supply interruptions. Gas supply from several sources will also enhance security of supply.**

The Petroleum Sector and Implications from Increased Demand of Gas

12. The petroleum sector faces substantial challenges in Lebanon, which result in inefficiency and uncompetitive pricing to the consumer. These challenges include the following:

- A lack of efficient competition in the import and distribution of oil products;
- The monopolization of the import and distribution of liquefied petroleum gas (LPG) by a single company;
- The lack of open access to oil product storage facilities and terminals;
- The continuous involvement of the government in the import and distribution of oil products;
- Relatively low taxes on gas oil compared with middle- and higher-income countries; and
- Administered pricing arrangements that provide relatively high and fixed distribution and profit margins to companies

13. **To enhance efficiency, transparency, and pricing to consumers, the Government of Lebanon should (a) restructure the oil products market and reform the pricing regime to allow for efficient competition in the importation and distribution of oil products; (b) create fair and open access to storage facilities; (c) introduce competition in the import and distribution of LPG; and (d) gradually reduce its role in the sector by focusing on regulating quality and safety standards for oil products and creating safety nets for vulnerable customer groups in the transition to more efficient market and pricing structures.**

The Potential for a Refinery in Lebanon

14. The Lebanese market for refined oil products is relatively small and, with the introduction of natural gas for power generation demand for certain oil products, in particular heavy distillates such as fuel oil and gas oil, is expected to decrease over the coming years. This study analyzes the potential for renewed refinery capacity in Lebanon (the two existing refineries ceased operation in 1989 and 1992 and are currently only used as import terminals and storage facilities for refined oil products), and concludes that the economics for building a new refinery in Lebanon in the short-term would be challenging as attracting finance could prove difficult because of the following:

- Lebanon does not have indigenous oil reserves. Without its own source of crude oil, it will be fully dependent on the import of crude oil at prices determined on international petroleum markets.
- Any new refinery in Lebanon will produce fuel oil and other oil products, which have to find a domestic and international market. The domestic demand for these products will decline with the introduction of natural gas and there is a limited market potential to export fuel oil and other oil products given the region's excess capacity.
- International petroleum product markets are highly competitive, and there are multiple sources of supply to cover the demand for oil products in Lebanon.

- Finally, considering the need to import crude oil, it is unlikely that the construction of a new refinery will increase the security of energy supply of Lebanon. The latter being the key justification expressed by the MEW for a new refinery.

15. In the longer run, however, should Lebanon be able to tap into very cheap crude oil, the economics of a domestic refinery may be more positive. **This Study recommends that (a) the decision of whether or not, and when, to enter the refining market in Lebanon be assessed by the private sector who would be the financier and assume commercial and operational risk; and (b) the government acts only as a business developer to facilitate investment.**

The Gas Market Structure

16. To meet future demand, Lebanon will, within a reasonably short period, be faced with multiple sources of gas. This, therefore, naturally gives rise to competition in the supply of gas.

17. Effective competition, however, can only evolve if there are multiple players in the market. In the initial phase, the MEW will control the gas import, shipping and supply, and consumption market in Lebanon. In the short term and with the limited volume of gas being purchased, a single buyer (that is gas importer) and seller (that is supplier) may be appropriate in the Lebanese gas market considering the economies of scale and scope involved in the purchase and sale of natural gas. To improve the future market, it is important that no party in the Lebanese gas market has an exclusive right to import and sell gas that would prevent other players from entering the market and possibly providing a better deal for customers. This Study, therefore, takes a long-term view and recommends that policy and regulatory decisions be taken today that will provide for the Lebanese gas market of tomorrow.

18. **The following key principles for the development of a competitive gas market structure are recommended: (a) unbundle monopoly transportation activities from competitive import, shipping, and supply businesses through—at a minimum—separate accounts; (b) separate commodity gas contracts from transportation contracts; and (c) create a regulated third-party access (RTPA) regime to transportation network.**

Legal and Regulatory Framework for the Gas Sector

19. To assist and promote a speedy development of the downstream gas sector, the establishment of an efficient regulatory system is crucial. Economic regulation will ensure that consumers receive good service at a reasonable price, and at the same time regulated businesses are allowed to recover their prudently incurred costs and make a reasonable rate of return. Economic regulation in Lebanon requires the following:

- Establishment of a regulatory regime based on primary gas legislation and subordinate legislation;
- Separation of regulatory functions from policy;
- Creation of wholesale competition by allowing large gas customers to choose their own supplier; and
- Creation of a joint gas and electricity regulator.

20. **To establish a competitive gas market structure, the Government of Lebanon should (a) develop and implements primary legislation (that is, a Model Gas Law) that will govern the downstream gas market in Lebanon; and (b) set up a joint gas and electricity regulator (or multi-sector regulator) to regulate the industry.**

Benefits from the Introduction Natural Gas

21. Lebanon can expect significant benefits from the introduction of natural gas. Key benefits include the reduction of power production costs and environmental benefits that are associated with switching from oil to the relatively cleaner natural gas.

22. The conversion from gas and fuel oil by major power plants in Lebanon has been estimated by the MEW to generate annual savings between **US$90 million** (at a Brent oil price of US$20/barrel) to **US$140 million** (US$30/barrel). In addition, close to **US$10 million** annually has been estimated to be saved from reduced operation and maintenance (O&M) costs. World Bank estimates confirm the significant savings potential. Calculations carried out for Bedawwi and Zahrani, the two CCGTs, suggest savings of up to **US$150 million/year** per plant should plant reliability be increased to industry standards and operating hours per year reach 3,500 GWh/year.

23. The introduction of natural gas to Lebanon also is expected to have a significant positive impact on the environment, notably on air quality. The potential benefits to Lebanon have been estimated in terms of avoided damage costs (the negative externalities) from the introduction of natural gas, and the results indicate a reduction in the environmental and health damages by between **US$740 million and US$1.8 billion for the period 2005–20**.

1. Lebanon's Energy Balance and Potential Gas Demand

1.1 Lebanon's total energy demand in 2002 was around 208 million Gigajoul (GJ). Given the lack of domestic energy sources, Lebanon almost entirely relies on imported oil products, and non-fossil domestic sources of energy, mainly hydropower, play a minor role. Lebanon is unable to import crude oil for processing, given that the country's two refineries in Zahrani and in Tripoli have been out of operation for the last decade.

1.2 This chapter discusses the current Lebanese energy balance and the structure of energy supply and demand in 2002.[4] It also provides estimates for future electricity and natural gas demand.

SOURCES OF PRIMARY ENERGY

1.3 The energy balance of Lebanon primarily includes oil products, namely gas oil (that is, diesel), fuel oil, gasoline, liquefied petroleum gas (LPG), and kerosene. Non-fossil fuels include hydro-power and alternative sources of energy, such as solar and wind.

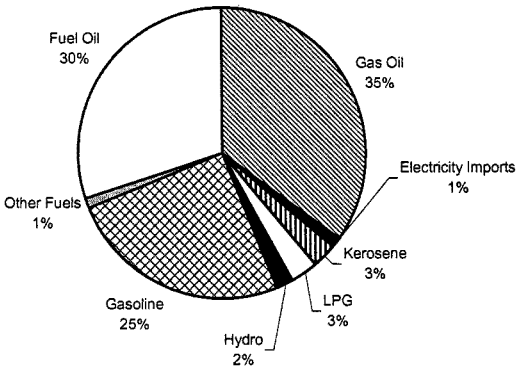
1.4 In 2002, 35 percent of the total energy supply was gas oil, a medium distillate oil used to produce diesel fuel for transportation and power generation; and 31 percent was fuel oil, a heavy distillate oil mainly used for power generation and industry. Gasoline used in the transport sector accounted for 25 percent of energy supply. Kerosene for jet engines and LPG, mostly used in the residential sector for cooking purposes, each accounted for about 3 percent of the energy sources. Hydro, the only source of domestic energy, accounted for only 2 percent of primary energy supplied. Electricity imports from Syria and other fuels (such as charcoal and wood) made up the remaining share of fossil energy sources in Lebanon.

1.5 Figure 1.1 below provides an overview of the various sources of primary energy in Lebanon in 2002.[5]

[4] Energy balances distinguish between primary energy and delivered energy. Primary energy focuses on the sources of supply and faces the challenge that non-fossil forms of energy (such as hydro) must be converted to primary energy equivalent using conversion ratios. Delivered energy measures all energy at the point of consumption and is useful to show the structure of usage of final fuels. This is especially important when the focus is on fuel products, as is the case in Lebanon. Delivered energy is measured after taking into account losses in conversion (mainly electricity generation). For the energy balance presented in this document, consideration was given to both primary energy and delivered energy.

[5] The various sources of primary energy in Lebanon have remained relatively stable over the last decade with the exception of the substitution of unleaded gasoline for leaded gasoline over the last five years. To date, unleaded gasoline accounts for 23 percent of primary energy sources and leaded gasoline for 2 percent, respectively.

Figure 1.1. Sources of Primary Energy, 2002

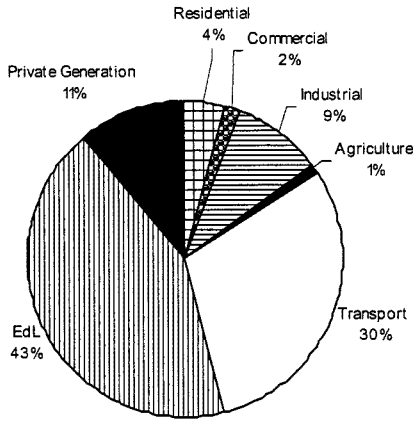


Note: LPG = liquefied petroleum gas.
Source: The Petroleum Directorate and Electricité du Liban (EdL), Lebanon, 2003.

DELIVERED ENERGY TO CUSTOMERS

1.6 Power generation accounted for 54 percent of delivered energy in Lebanon in 2002, of which 43 percent was used by Electricité du Liban (EdL), the national electricity utility, and the remaining 11 percent by private generators. The relatively high rate of self-generation by residential, commercial, and industrial customers is caused by the current lack of adequate electricity infrastructure coverage and frequent power brown- and blackouts.[6] The breakdown of delivered energy by consumer category is presented in Figure 1.2.

Figure 1.2. Delivered Energy by Consumer Category, 2002



Source: The Petroleum Directorate and EdL, Lebanon, 2003.

[6] A blackout is a complete loss of power. Brownouts are characterized by low voltage and power interruptions.

1.7 The transportation sector used about 30 percent of delivered energy in 2002. Gasoline is the main fuel in the transportation sector, accounting for about 82 percent of energy consumed. Kerosene and gas oil make up the remaining 18 percent, each accounting for about 9 percent.

1.8 The industrial sector only consumed 9 percent of total delivered energy in 2002, illustrating the country's relatively small industrial base. Lebanon has some industries, such as cement and ceramics factories, but the economy relies heavily on the service and tourism industries for economic growth. Within the industrial sector, fuel oil accounts for about 75 percent of delivered energy, followed by gas oil with 16 percent, LPG with 5 percent, and other fuels with 4 percent.

1.9 LPG is an important fuel in the residential sector, where it is mostly used for cooking and heating purposes and accounts for about 49 percent of energy usage. Gas oil accounts for 44 percent of residential usage mostly for space heating. Other fuels, such as wood and charcoal, are also used in the residential sector and account for about 7 percent of energy usage.

1.10 Finally, commercial customers and agriculture account for about 3 percent of delivered energy usage in Lebanon, mostly using gas oil (71 percent), LPG (16 percent), and other fuels (13 percent). Annex 2 provides detailed tables of the energy balance in Lebanon from 1998 through 2002.

THE KEY ROLE OF THE POWER SECTOR AND SCOPE FOR INCREASED USE OF NATURAL GAS

1.11 The power sector accounts for more than half of Lebanon's energy demand. Given the importance of this sector in the overall energy and fiscal balance of the country, as well as in the future gas industry, this chapter assesses (a) the characteristics of the Lebanese power sector; (b) the electricity demand forecast; (c) the scope for power generators to switch from fuel and gas oil to gas; and (d) the potential long-term demand for natural gas.

The Characteristics of the Lebanese Power Sector

1.12 The initial market for gas in Lebanon will be relatively small and consumption will be anchored in power plants running on natural gas. The financial viability of the power sector has major implications on the long-term viability of the natural gas sector in Lebanon. A major risk to the sustainability of a future gas market in Lebanon is the ability of final consumers to pay for their gas consumption. The largest consumer of natural gas will be EdL. EdL has a very weak financial position and is the recipient of significant operating and investment subsidies from the government. The introduction of gas will help reduce the operating cost of EdL to a large extent, but additional efficiency improvements are required to assure its financial viability.

1.13 Factors that affect EdL's operational and financial performance include the following:

- A persistent high level of unbilled electricity consumption, which amounted to close to 50 percent in 2002, of which 33 percent is estimated to be due to commercial losses (for example, theft);
- Poor customer data base preventing proper billing and collection;
- Substantial transmission capacity constraints due to lack of investment in substation and transmission lines, particularly in the Saida and Ba'albeck regions; and
- Weak institutional capacity due to understaffing in key technical and managerial areas and lack of arms length relationship between the government and the company.

1.14 Finally, the Lebanese electricity sector continues to be dominated by EdL, a vertically integrated monopoly that owns and operates generation, transmission, and distribution networks and acts as the sole electricity retailer. The Lebanese Government aims to restructure and reform the power sector and passed "The Law of Electricity Sector Organization" in September 2002. This law sets out the rules and principles governing the sector, including the role of the government in this sector, the establishment of the regulator, and the role of the private sector.[7] Although the provisions exist in the law for privatization and competition, no action has been taken yet to implement the law. Having said that, the Lebanese Government envisaged to privatize EdL a few years ago but abandoned the privatization strategy recommended by its advisers based on the weak financial position of EdL and the unlikely generation of significant proceeds from the sale.

1.15 The situation has now reached crisis dimensions, with EdL losing up to US$400 million per year. This situation is further aggravated by poor collection performance and high oil prices. In 2000 (the most recent audit report), EdL had accumulated losses close to US$1 billion. Since then, losses are reported to have increased significantly and EdL is considered bankrupt.

1.16 **The Government of Lebanon should put in place an immediate interim Management Contract for EdL focused on an operational and financial turnaround. In parallel, a longer-term strategy for restructuring the power sector aimed at private sector participation and competition should be formulated and adopted by the government.**

Electricity Demand Forecast

1.17 Following the cessation of hostilities in the early 1990s and subsequent reconstruction efforts, Lebanon's electricity demand experienced a period of high average demand growth of around 16 percent between 1992–96.[8] The high concentration of the Lebanese population in urban and semi urban areas, combined with rehabilitation of crucial networks, enabled the reconnection of relatively large proportions of the population to grid-supplied electricity. Since the late 1990s, electricity demand growth has slowed and averaged around 3.5 percent per year.

1.18 There is an ongoing need for rehabilitation of transmission and distribution networks in mostly rural parts of the country that are currently not connected to EdL's main grid. In addition, the system suffers from high technical and non-technical losses, mostly caused by theft and inadequate metering. Frequent brown- and blackouts on the main grid, in particular at peak periods, have encouraged private generation to produce non-grid-supplied electricity that tends to be more expensive because of fuel costs and economies of scale. Currently, private generators are estimated to account for about 20 percent of total electricity production. There seems to be a significant amount of suppressed electricity demand in Lebanon, particularly during peak periods.

1.19 Table 1.1 below provides an overview of estimates of future electricity demand growth scenarios until 2020. Three different scenarios for future electricity demand in Lebanon were produced, covering base, low, and high demand scenarios. Each scenario makes different assumptions regarding future gross domestic product (GDP) growth rates, price elasticity of demand for various sectors and consumer categories, changes to electricity prices, reduction of electricity transmission losses, energy efficiency developments, and the return of customers to grid-supplied electricity. Annex 3 presents the detailed assumptions and adopted methodology for estimating future electricity demand scenarios in Lebanon.

[7] The Law of Electricity Sector Organization (Law #462 issued on 05/09/2002).
[8] World Bank. 1999. *Energy Strategy into the Next Millennium.*

Table 1.1. Electricity Peak Demand Forecast (in MW)

	2004	2005	2010	2015	2020
Base Case	2,149	2,201	2,419	2,644	2,961
% Growth	*2.4*	*2.4*	*1.9*	*1.8*	*2.3*
Low Case	2,048	2,050	2,051	2,225	2,401
% Growth	*0.1*	*0.1*	*0.0*	*1.6*	*1.5*
High Case	2,362	2,528	3,412	4,398	5,110
% Growth	*7.0*	*7.0*	*6.2*	*5.2*	*3.1*

Note: MW = megawatts. Growth figures until 2005 are per year and for the period 2005–20 are five-year averages.
Source: Chubu Electric Power Company Ltd. (CEPCO), 2004.

1.20 Electricity demand is expected to grow relatively fast in the medium to long term under the base-case and high-case scenario. However, the level of demand growth will depend on the speed of rehabilitation of network and reform and restructuring measures carried out in the electricity sector.

Characteristics of Existing Power Plants

1.21 The total installed thermal capacity of EdL is 1,963 megawatt (MW), of which 1,243 MW are steam turbine units and 720 MW gas turbine units. Gas turbine units use diesel oil to generate electricity, and steam units use fuel oil. In addition, Lebanon has approximately 280 MW of hydroplants with seasonal production depending on rainfall.

1.22 Of the 1,770 MW thermal capacity available in Lebanon, 870 MW (49 percent) is ready to receive natural gas. There are the two Combined Cycle Gas Turbine (CCGT) plants (one at Bedawwi and one at Zahrani) that have already installed dual fuel capabilities (that is, natural gas and gas oil) and can convert to natural gas at negligible additional costs.[9]

1.23 The power plants in Tyre and Ba'albeck have installed gas turbines that are designed to burn gas oil. To switch to natural gas, additional gas burners will have to be installed, requiring some additional capital investment. Jieh and Zouk, with a combined installed and available capacity of 953 MW and 815 MW, respectively, use steam turbines and would have to incur substantial conversion costs to be able to receive natural gas. The existing thermal power plants (TPPs) and units are listed in Table 1.2. The table also indicates whether plants are currently able to receive natural gas at low conversion costs.

[9] To enable these plants to generate electricity from natural gas, some adjustment to the gas burners is required to allow for optimal operation and conversion efficiency.

Table 1.2. Thermal Power Plants

Plant	Unit No.	Type	Manufacturer	Operation Year	Installed Capacity (MW)	Available Capacity (MW)	Ready to Receive Gas at Low Conversion Cost?
Zouk	1	ST	Ansaldo	1984	145	115	—
	2	ST	Ansaldo	1985	145	115	—
	3	ST	Ansaldo	1986	145	130	—
	4	ST	Alstom	1987	172	160	—
	Total Zouk				**607**	**520**	**No**
Jieh	1	ST	Toshiba	1970	65	55	—
	2	ST	Toshiba	1970	65	40	—
	3	ST	BBC	1980	72	70	—
	4	ST	BBC	1981	72	65	—
	5	ST	BBC	1981	72	65	—
	Total Jieh				**346**	**295**	**No**
Tyre	1	GT	G.E.	1996	35	35	—
	2	GT	G.E.	1996	35	35	—
	Total Tyre				**70**	**70**	**Yes**
Ba'albeck	1	GT	G.E.	1996	35	35	—
	2	GT	G.E.	1996	35	35	—
	Total Ba'albeck				**70**	**70**	**Yes**
Zahrani (CCGT)	1	GT	Ansaldo	1998	145	145	—
	2	GT	Siemens	1998	145	145	—
	3	ST	Ansaldo	2001	145	145	—
	Total Zahrani				**435**	**435**	**Yes**
Bedawwi (CCGT)	1	GT	Ansaldo	1998	145	145	—
	2	GT	Siemens	1998	145	145	—
	3	ST	Ansaldo	to be determined	145	145	—
	Total Bedawwi				**435**	**435**	**Yes**
Total in six power plants					**1,963**	**1,770**	—

— No local data available.
Note: MW = megawatt; GT = gas turbine; ST = steam turbine; BBC = Brown, Boveri & Co.; G.E. = General Electric
Source: Data from EdL as of April 2003.

Potential for Conversion to Natural Gas

1.24 There are two principal methods for converting power plants to burn natural gas. The first option is a simple gas conversion, which is accomplished by modifying the fuel system of the existing units. The second option is to re-power an existing plant by converting the system to a CCGT. The first option tends to leave the plant with the same generation capacity whereas converting to combined cycle increases the generation capacity of a plant.

1.25 The merit for converting existing power plants to natural gas will depend on the cost of conversion and the availability of natural gas and construction of a pipeline network. Bedawwi and Zahrani both have installed CCGTs, but only Bedawwi will be able to receive gas from Syria when the GASYLE Pipeline is finished in late 2004. The supply to Zahrani will require a new transmission pipeline network, such as the construction of the National Gas Pipeline or the construction of a liquefied natural gas (LNG) facility if economically viable.

1.26 The potential to convert the Tyre and Ba'albeck gas turbine plants will depend on the construction of new gas pipeline network. The relatively small size of the two plants and associated low gas consumption levels, combined with the relatively remoteness of the Ba'albeck plant, may not justify the construction of a pipeline specifically to supply these plants.

1.27 Two of the 65 MW units at the oil-fired power plant at Jieh were commissioned in 1970 and are now more than 34 years old. The other three 72 MW units were commissioned in 1980 and 1981 and are 24 years old. The plant is well maintained and in good operational condition, but plant efficiency is relatively low by modern standards. The plant has a comparatively high reliability and a 68 percent capacity factor despite its low position in the dispatch merit order, and normally serves as an emergency backup and peaking plant. The relatively low fuel consumption level and limited use of this plant for emergency backup and peaking periods may not justify the conversion to natural gas based on costs.

1.28 The Zouk TPP is the largest power plant in Lebanon. It is a base-load fuel oil-steam plant located in the suburban area of North Beirut. The cost of converting the fuel system of Zouk to natural gas is estimated at US$20 million. The cost of converting it to a CCGT, and potentially increasing its output from 520 MW to 952 MW, is estimated to cost US$430 million.[10]

1.29 **Considering the relatively old age of the Jieh power plant and the likely restricted use of the plant as a backup and peaking plant, it should continue to operate as an oil-fired plant until its retirement. The potential for conversion of Tyre and Ba'albeck and the supply to Zahrani power station, which is ready to receive gas, will depend on the construction of the National Gas Pipeline and additional pipeline network and gas infrastructure that may be required. The conversion of Zouk will also require new pipeline development and the Government of Lebanon carefully should review the cost of the two gas conversion options taking into consideration future electricity demand forecasts. A feasibility study for the National Gas Pipeline and its routing is currently being conducted by Tractebel and the potential costs and benefits of delivering natural gas, including conversion costs, to Tyre, Ba'albeck, Zahrani, and Zouk power stations should be evaluated in detail in this study.**

FUTURE NATURAL GAS DEMAND

1.30 The demand for gas in Lebanon will be determined by a number of factors, including (a) the current and future demand of the power sector; (b) non-power sector demand; (c) the pricing of various supply options; and (d) the development of critical infrastructure required to bring gas to Lebanon. This section will deal with the potential demand in the power and non-power sectors. Supply options and infrastructure requirements will be discussed in the next section.

1.31 The future demand for natural gas in Lebanon is driven by the conversion rate of current power plants, the reduction of private electricity generation and reconnection to grid supply, and the construction of new CCGT plants to cover future electricity demand. It is estimated that the power sector will account for more than 75 percent of future gas consumption. Table 1.3 provides estimates of future natural gas

[10] CEPCO estimates 2004.

demand until 2020. Demand in Lebanon is estimated to grow from 1.5 MMCM/day in 2005 to close to 10 MMCM/day in 2010 and 12.10 MMCM/day in 2020.

1.32 Demand will initially come from the supply to the Bedawwi power station, but the estimates indicate a large increase between 2005 and 2010 from 1.5 MMCM/day to almost 10 MMCM/day. This assumes supply to the Bedawwi, Zahrani, and Zouk power stations and the construction of new CCGT plants to cover additional electricity demand. It also assumes a continuous reduction of private generators, which mostly use gas oil, and the reconnection of these customers to the main grid supplied by electricity generated from natural gas.

Table 1.3. Demand Forecasts for Natural Gas (MMCM/day)

	2005	2010	2015	2020
Residential	minimal	minimal	minimal	minimal
Commercial	minimal	minimal	minimal	minimal
Industrial	0.00	1.80	2.40	2.87
Power Sector	1.50	8.07	8.55	9.23
Total	**1.50**	**9.87**	**10.95**	**12.10**

Note: MMCM/day = million cubic meters per day.
Source: CEPCO 2004.

1.33 The future non-power gas demand has been estimated by using the netback methodology. This approach analyzes potential gas consumption of the residential, commercial, and industrial sectors by analyzing usage of competing fuels for specific usage. The assumptions and methodology of the netback analysis are discussed in detail in Annex 4.

1.34 In the residential and commercial sectors, the two main potential sources of gas demand are cooking and space heating. These sectors currently use relatively expensive bottled LPG and gas oil, and the potential for residential and commercial customers to switch to natural gas could have significant impacts on interfuel competition and eventually on fuel costs. Table 1.4 shows total energy volumes of gas oil, LPG, and other fuels in the commercial and residential sector in 2002. Overall, both sectors consumed approximately 12 million GJ of energy in 2002, or 6 percent of total delivered energy to Lebanon in that year.

Table 1.4. Residential and Commercial Consumption Pattern, 2002

Energy Usage (GJ)	Gas Oil	LPG	Other Fuels
Residential	2,730,000	4,250,000	670,000
Residential Space Heating	1,060,000	—	—
Commercial	1,834,000	566,000	450,000
Commercial Space Heating	711,000	—	—
TOTAL (GJ)	**6,535,000**	**4,816,000**	**1,120,000**

— Not available.
Note: GJ = Gigajoul; LPG = liquefied petroleum gas.
Source: CEPCO 2004.

1.35 The demand for natural gas for residential and commercial usage is relatively small and space-heating requirements are limited in Lebanon because of the relatively mild and short heating season. Natural gas, however, could be used as a potential substitute for relatively expensive LPG and gas oil in these sectors. This would require the development of a distribution network that is capital intensive and only economically justifiable when there is a large number of connections and relatively high gas

throughput volumes. A large percentage of the population in Lebanon live in urban and semi urban areas, and there may be a potential to construct a distribution network in densely populated areas, such as Beirut, particularly once a transmission network has been built.

1.36 There is also a potential for usage of natural gas in the industrial sector, and it has been estimated that this could account for around 1.8 MMCM/day by 2010 and 2.87 MMCM/day by 2020. The Lebanese economy is based primarily on the service and tourist industries and some intermediate light industries. However, there is some heavy industry—including cement, fabricated metals, paper, glass, ceramics, rubber, and plastics—where fuel oil is currently used for furnaces and boilers. Potential industrial, commercial, and domestic demand may make the construction of a distribution network in the Beirut area financially viable.

1.37 **The Government of Lebanon should implement a conversion strategy for the Lebanese power sector that allows for maximum use of natural gas, as well as studies the feasibility of a non-power sector gas distribution network.**

2. Gas Supply Options

2.1 To date, there are no proven gas reserves in Lebanon. Some offshore seismic surveys were shot in 1994, and a further, more extensive, survey was carried out in 2002. According to the Ministry of Energy and Water (MEW), the seismic data has revealed some interesting leads and, in particular, the possibility that the gas fields recently discovered offshore in Egypt, Palestine, and Israel may extend to Lebanese waters and jurisdiction.[11]

2.2 At this stage, it is too early to speculate about potential reserves. Lebanon may have gas reserves that are economically viable, which could provide an alternative source of energy. However, considering the lead-time for developing a field and the associated infrastructure, domestic gas reserves would take time to develop.

2.3 Natural gas demand forecasts in Table 1.3 show that gas demand may quadruple between 2005 and 2010, requiring Lebanon to import about 10 MMCM/day of natural gas to meet domestic demand by the end of this decade. The current contractual arrangements with Syria are insufficient and only cover about half of that volume; therefore, Lebanon will have to find additional supply sources to meet the demand.[12]

2.4 In January 2003, an agreement between Lebanon, Jordan, Syria, and Egypt was signed declaring the four countries' intent to develop a regional gas pipeline (the Arab Gas Pipeline) going from Egypt to Lebanon (via Jordan and Syria).[13] The construction of the first phase of the pipeline from Arish in Egypt to Aqaba in Jordan, a 260 km pipeline segment, has been completed. A project agreement on the second phase, a 390 km pipeline from Aqaba to Rehab in Amman was signed in January 2004 and construction has started. The Lebanese Government is currently in the process of discussing a gas sales agreement with Egypt.

2.5 This chapter (a) discusses regional gas sources for piped natural gas; (b) assesses the potential for LNG supply; (c) estimates natural gas prices from different sources; and (d) discusses security of supply.

POTENTIAL REGIONAL SOURCES FOR PIPED NATURAL GAS

2.6 There are four major factors that determine the viability of a potential source of piped gas for supplying the Lebanese market, including the following:

- Level of proven reserves in the region;
- Connection of natural gas reserves and the emergence of a regional pipeline network;
- Cost of gas production; and

[11] Further evaluation of this seismic data is currently being carried out and, assuming a positive outcome, the Lebanese Government is planning to start an offshore licensing round in 2004/05. At the same time, the government is in the process of developing a Petroleum Law that regulates the licensing of the offshore area.

[12] Under the 25-year contract with Syria, the Petroleum Syrian Company (PSC) shall sell the Ministry of Energy and Water (MEW) up to 6 MMCM/day. In the early stage, PSC will deliver 1.5 MMCM/day and gradually reach 3 MMCM/day in the first stage and 6 MMCM/day in the second stage. Both parties will have to agree to determine the time schedule and contractual conditions for the first and second stages. According to the MEW, up to 3 MMCM/day is certain. Between 3 MMCM and 6 MMCM/day will have to be negotiated further.

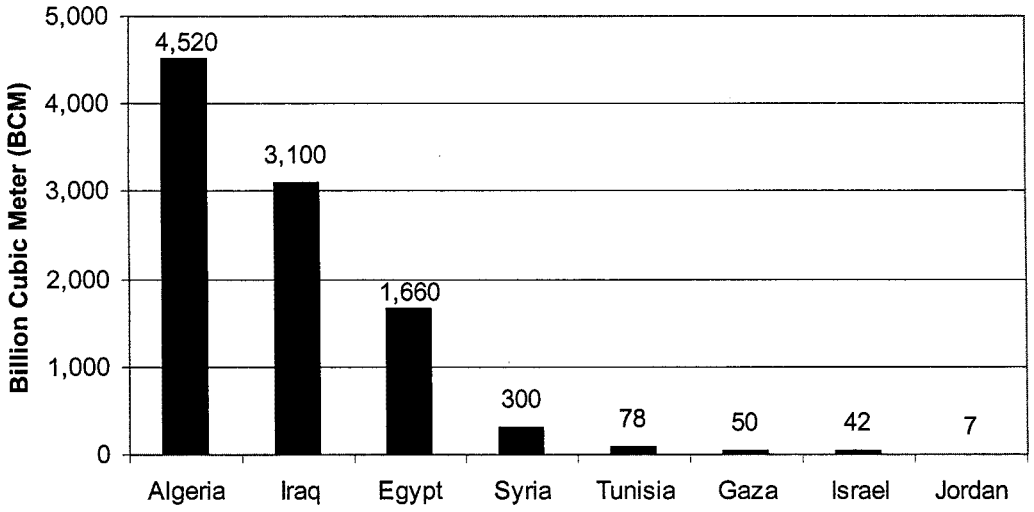
[13] In June 2002, the four countries signed two agreements of principles for the establishment of the Arab Gas Authority and the founding of the Arab Company for Natural Gas Transportation and Marketing, paving the way for the execution of the Arab Gas Pipeline project.

- Distance from consumers.

Level of Proven Reserves in the Region

2.7 Natural gas reserves are classified according to their probability of production. The "proven" reserve category is the most certain and is based on a 90 percent probability of being produced.[14] Proven gas reserves in the Mediterranean region are shown in Figure 2.1.

Figure 2.1. Regional Proven Gas Reserves, 2002



Sources: British Petroleum Statistical Review of World Energy 2003, CEPCO 2004, Cidigaz 2003, and Organization of Arab Petroleum Exporting Countries (OAPEC) 2001.

2.8 With about 4,500 billion cubic meters (BCM) of proven reserves, Algeria has the largest proven reserves in the region, followed by Iraq and Egypt. Algeria is the largest gas producer in the Mediterranean region, with onshore gas fields that are large in size, which keeps gas production costs relatively low. Low production costs combined with the geographic proximity to Spain and Italy makes Algeria a major exporter of natural gas to Europe.[15] The Algerian gas network is not connected to the East Mediterranean, and considering the distance, it is unlikely that Algeria piped gas will be a competitive supply option for Lebanon in the near future.

2.9 Natural gas reserves in Egypt have increased rapidly over the last few years, based on large offshore discoveries and were estimated at about 1,660 BCM in 2002. Egypt is expecting to become a major gas exporter in the near future, supplying the Mediterranean and international markets through piped gas and LNG. Production costs in Egypt are higher than in Algeria because of increased costs associated with offshore production. The proximity to the East Mediterranean, however, and lower transportation costs and the current construction of the Arab Gas Pipeline may provide Lebanon with the viable alternative of importing gas from Egypt in a few years.

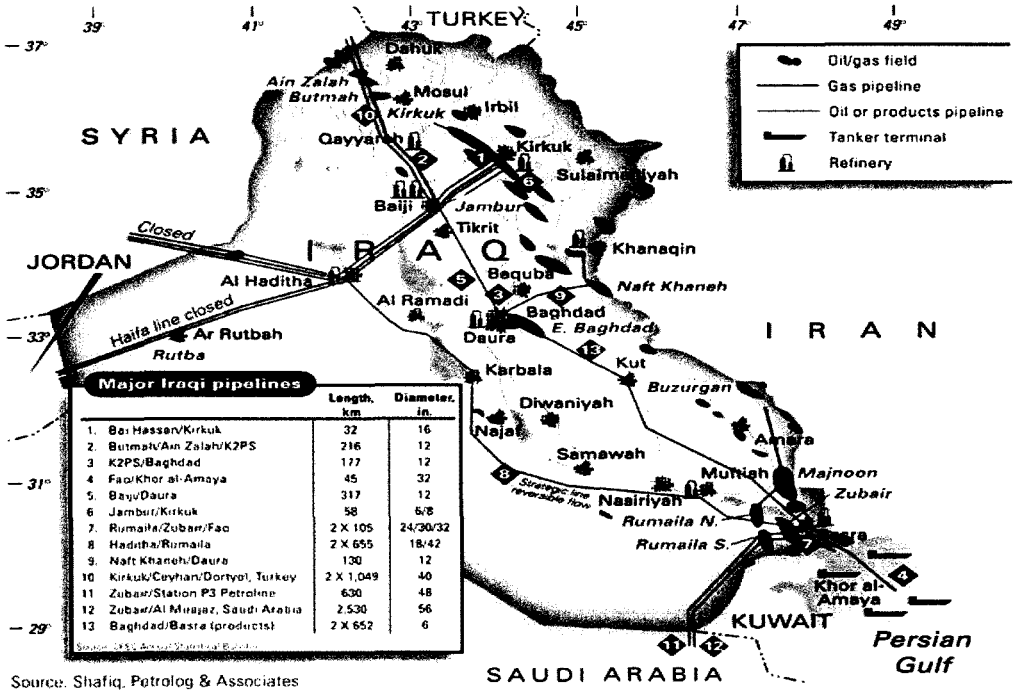
[14] Gas (and oil) reserves only become "proven" when there is a route to a market, preferably a pipeline or a liquefaction plant with a contracted customer at the other end of the supply chain. The most frequently quoted example of known gas reserves not being counted as proven is Alaska, where large gas reserves have been identified but await a pipeline to take them to market. For now the reserves are not proven.

[15] Algeria exported about 20 BCM of piped natural gas to Europe in 2003.

2.10 Iraq has proven gas reserves of about 3,100 BCM that are currently unutilized. A large non-associated gas field in the Akas region of western Iraq near the border with Syria was discovered in 2001 containing an estimated 58.8 BCM of natural gas reserves. Iraq is currently a major associated gas flaring nation, and the World Bank estimates annual flaring volumes to reach 20 BCM. Iraq needs significant network investments and, under the current economic and political climate, it is difficult to see Iraq as a key gas exporter in the short term. However, once the pipeline network and operation have been rehabilitated, there is a large potential for export of associated and non-associated Iraqi gas to the East Mediterranean region, including Lebanon.

2.11 Figure 2.2 shows the current gas (and oil) pipeline network in Iraq and interconnections with neighboring countries. There is a transmission gas pipeline running from Port Basra in the South of Iraq to Baiji (via Kut and Baghdad), Al Haditha, and the Syrian border. Currently, no gas is flowing between Iraq and Syria, but this pipeline could become a key source of natural gas in the East Mediterranean in the medium term once the pipeline and production facilities have been reconnected and rehabilitated.

Figure 2.2. Iraqi Gas and Oil Pipeline Routes



Source: *Oil and Gas Journal* December 2003.

2.12 Estimates of Syrian natural gas reserves in 2003 varied between 240 BCM and 371 BCM.[16] Syria is also reported to have a relatively high reserve/production ratio of 59 years, suggesting that there may be additional gas quantities available to supply the Syrian and East Mediterranean market, including Lebanon. In April 2004, the Syrian Ministry of Petroleum and Mineral Resources selected three companies to negotiate production sharing contracts for the development of 15 gas discoveries, located in two clusters: one east of the city of Homs and the others south-west of Alleppo. The discovery containing 1.2 BCM of gas made near Homs in July 2003 may be particularly relevant for Lebanon and the GASYLE Pipeline. Production is targeted to start in 2007. No estimated reserve and production data are currently available. Syria will be the major gas exporter to Lebanon in the short to medium term.

[16] The BP Statistical Review of World Energy estimated the reserves at 240 BCM, Cidigaz at 300 BCM, and OAPEC (Organization of Arab Petroleum Exporting Countries) at 371 BCM.

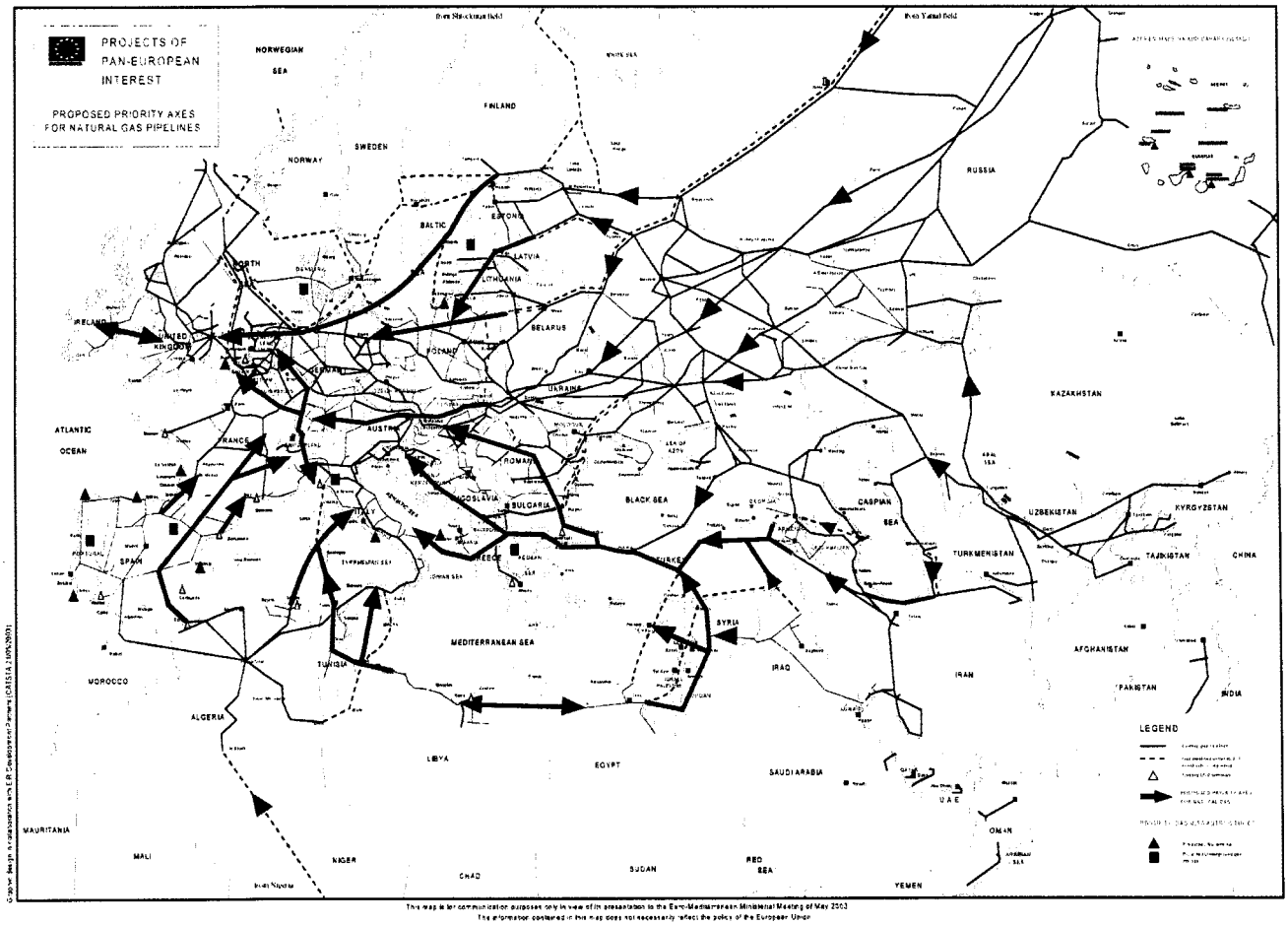
2.13 Proven gas reserves in Tunisia, Israel, and Jordan are relatively minor and mostly used or earmarked for the domestic market.[17] Contingent gas reserves recently have been discovered in offshore Gaza. These countries are unlikely to have the reserves or network to supply gas to Lebanon in the near future.

Connection of Natural Gas Reserves and the Emergence of a Regional Pipeline Network

2.14 The gas transmission network in the East Mediterranean is currently underdeveloped and lacks interconnection. The major producer, Algeria, is not connected to the East Mediterranean. A sub-regional gas pipeline network is slowly beginning to develop with the construction of the Arab Gas Pipeline. The map in Figure 2.3 provides a graphic overview of the existing pipeline network and planned routings of new pipelines in the region.

[17] According to GasMatters (May 2004), Israel Electric Corporation (IEC) plans to buy 1.2 BCM/year (about 3 MMCM of gas from Egypt in 2006, rising to 1.7 billion cubic meters/year (BCM/year) in July 2007 for the subsequent 14 years. The gas will be supplied to IEC by the Israeli-Egyptian company Eastern Mediterranean Gas (EMG). The 15-year deal is estimated to be worth $2.5 billion.

Figure 2.3. Regional Natural Gas Pipeline Network



Source: European Union 2003.

2.15 The current gas infrastructure in the region is limited. For Lebanon, an important first step in connecting to the regional gas network will be the pipeline connection with the Syrian network. This connection could not only supply Lebanon with Syrian gas but, eventually, with gas from Egypt (once the Arab Gas Pipeline network has been constructed) and Iraq (once the network has been rehabilitated and reconnected to the Syrian network).

Cost of Gas Production

2.16 Natural gas production costs can vary significantly depending on (a) size of fields; (b) location (onshore or offshore); (c) type (gas field or associated gas);[18] (d) productivity of reservoir; (e) field facility costs; (f) presence of contaminants; and (g) hydrocarbon taxation.

2.17 Regional gas suppliers have different production cost characteristics. For example, Algeria has many large onshore gas fields with highly productive wells and therefore relatively low production cost. In contrast, Egypt has smaller fields, mostly located offshore with relatively high government hydrocarbon taxation, making overall production costs higher. The characteristics of gas fields in Iraq

[18] Associated gas is a blend of hydrocarbons that is released when crude oil is brought to the surface.

will enable the country to produce natural gas at relatively low costs once the pipeline and production facilities have been rehabilitated. A summary of the production cost indicators in countries that are particularly relevant for Lebanon are shown in Table 2.1 below.

Table 2.1. Comparison of Production Cost Indicators

Gas Fields	Egypt	Syria	Iraq
Size	Medium	medium	very large
Location	Offshore	onshore	onshore
Type	gas field	gas field/ associated gas	gas field/ associated gas
Productivity of Reservoir	Good	moderate	very high
Field Facility Costs	High	moderate	low
Contaminants	None	none	none
Hydrocarbon Taxation	High	moderate	not known at present

Source: CEPCO 2004.

Distance from Consumers

2.18 The cost of transporting gas to importing countries is a major factor in determining the overall cost of gas to final consumers. In the case of Lebanon, the geographic distance to Egypt increases gas transportation costs compared with Syria. In addition, given that the Arab Gas Pipeline is a cross-border pipeline, importers normally have to pay transit fees to neighboring countries where the pipeline crosses, further increasing the overall costs of gas.[19]

2.19 The cost of transporting Iraqi gas to the East Mediterranean will depend on the location of gas fields within Iraq, and some recent gas discoveries in Western Iraq (near the Syrian border), which may become an attractive source. Egypt's higher transportation and production costs may imply that Egyptian gas is less competitive in the region than Syrian or Iraqi gas in the long term.

2.20 Considering, however, that Syria has limited proven reserves and Iraq is unlikely to become a gas exporter in the short term, Egypt can play a major role in supplying gas to the East Mediterranean market once the Arab Gas Pipeline has been finalized.

2.21 **Lebanon should view its potential sources of gas based on when they may become available. In the short term, the only viable source is from Syria, where a contract is in place and the relevant pipeline connection is being constructed. In the medium term, gas from Egypt may become a viable option for Lebanon once the Arab Gas Pipeline has been finalized. In the long term, Lebanon, and the whole Mediterranean region, will benefit from the rehabilitation and reconnection of the Iraqi gas network, allowing the region to tap into large Iraqi gas reserves. In addition, in the longer term, Lebanon may prove to have its own reserves of gas.**

POTENTIAL FOR LNG SUPPLY

The Emergence of a Regional LNG Market

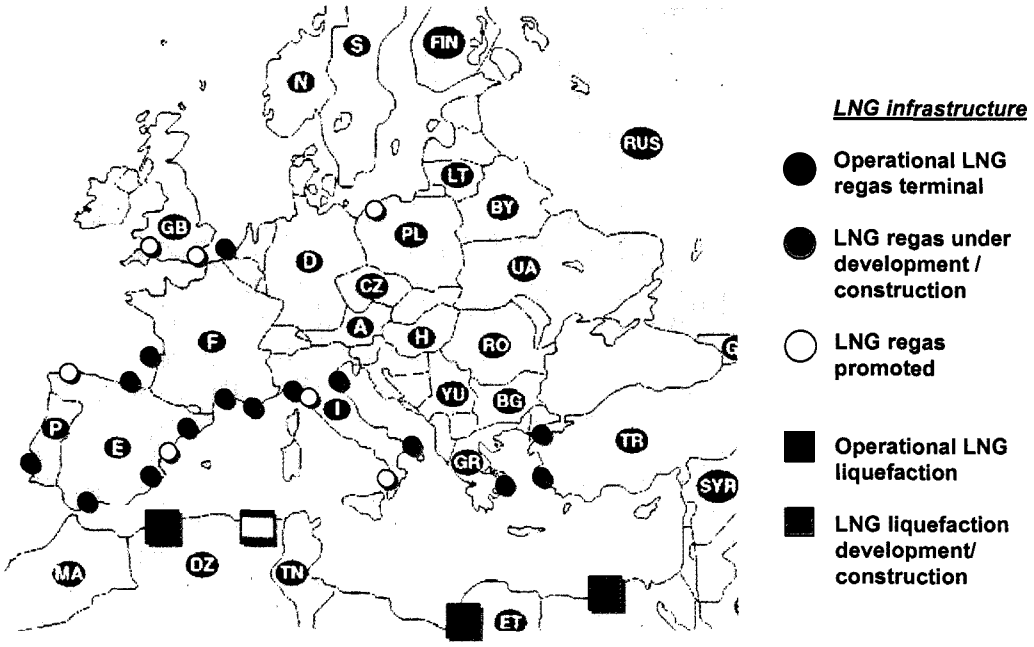
2.22 An alternative option to supply Lebanon with natural gas would be through LNG. LNG trade has been growing rapidly in the region and worldwide. With the introduction of new technologies, the cost of

[19] Robert Bacon and Paul Stevens. June 2003. *Cross-Border Oil and Gas Pipelines: Problems and Prospects.*

liquefaction and re-gasification has fallen over the last few years. As a result, LNG is increasingly competing with piped gas to supply markets in developing, middle-income, and industrialized countries. With the expansion of LNG, international gas markets have become more competitive and gas buyers can increasingly choose from alternative sources of gas supply.[20]

2.23 An active LNG market has emerged in the Mediterranean region over the last few years, and there are a number of LNG suppliers, including Algeria, Qatar, Oman, and Egypt. The largest supplier in the region is Algeria followed by Qatar. Currently, Egypt is finalizing the construction of a gas liquefaction plant that will allow the country to export natural gas from its offshore gas fields. Details of the various LNG facilities in the Mediterranean are shown in Figure 2.4 below.

Figure 2.4. Mediterranean LNG Infrastructure



Note: LNG = liquefied natural gas.
Source: BG Italia, 2004

Comparison of LNG and Piped Natural Gas Costs for Lebanon

2.24 Lebanon has the option of supplying the domestic market with natural gas, either through gas imported via a pipeline, LNG, or both. The potential role of LNG in the future gas import mix of Lebanon should be driven by cost considerations. Three major cost components determine the price of LNG in Lebanon, including (a) shipping cost; (b) regasification costs; and (c) LNG costs.

2.25 Shipping costs depend on the location of the LNG supply and the distance to the destination market. A likely source of LNG would be Algeria and/or Qatar and it has been estimated that the

[20] Franz Gerner and Bent Svensson. April 2004. "Public and Private Sector Roles in the Supply of Gas Services in Developing Countries." The World Bank.

transportation cost for the 2,058 nautical miles between Algeria and Lebanon would be US$0.29/million British thermal units (mmbtu).[21]

2.26 Based on a study carried out by Kellogg, Brown, and Root (KBR) in 2000, the regasification cost in Lebanon would be approximately US$0.76–0.79/mmbtu.[22] LNG costs have been estimated to be US$2.62/mmbtu at an oil price of $20/barrel. Table 2.2 summarizes the shipping, regasification, and import costs. Total LNG import costs in Lebanon at US$20/barrel are estimated at around US$3.70/mmbtu.

Table 2.2. Total LNG Costs

Cost	US$/mmbtu
LNG Cost (at US$20/barrel Crude)	2.62
Transportation Cost (Algeria to Lebanon)	0.29
Regasification	0.79
Total LNG Costs	**3.70**

Note: Estimates on regasification are based on 2000 data.
Source: CEPCO 2004.

2.27 Table 2.3 provides estimates for piped natural gas and LNG in Lebanon. Under the current market arrangements, LNG seems to be substantially more expensive than piped gas from Syria, Egypt, and Iraq. However, the economics of LNG may change in the near future, as liquefaction and regasification costs are expected to fall further. Additionally, new technologies are being developed, such as floating LNG regasification vessels.[23] These technologies have not been tested in the market, and it remains to be seen whether they are economically viable for relatively small gas markets such as Lebanon.

Table 2.3. Estimated Piped Gas and LNG Import Prices

Source	Earliest Availability	Price (US$/mmbtu)	Price Formulae
Syria	- 1.5 MMCM/day from January 2005 - Up to 3 MMCM/day available - Another 3 MMCM/day (that is, total of 6) possible through negotiations	2.4–3.4	- Priced at 80 percent of the Brent crude oil.
Egypt	- From 2008	2.9	- Priced at 87 percent of the Brent crude oil. - The price has been estimated taking account the price for Egyptian gas to Jordan, pipeline costs between Egypt and Lebanon, and contract prices previously agreed to between Egypt and Israel.

[21] Dewry Shipping Consultants publish annual liquefied natural gas (LNG) shipping costs based on a 135,000 cubic meter vessel.
[22] Various studies have been undertaken in Lebanon to review the cost involved in importing LNG through the construction of an LNG import facility. The most recent study was carried out by Kellogg, Brown, and Root (KBR) in September 2000. The study considers two sources for LNG: Algeria and Qatar.
[23] F. Faber, A. Bliaut. 2002. *Floating LNG Solutions—From the Drawing Board to Reality*, Shell International E&P Inc., Shell Global Solutions International BV, Offshore Technology Conference, Paper 14100.

Source	Earliest Availability	Price (US$/mmbtu)	Price Formulae
LNG	- From 2008	3.7	- Assumes LNG costs at US$20/barrel. - Assumes regasification costs of about US$0.79/mmbtu and transportation costs of about US$0.29/mmbtu.
Iraq	- From 2010	2.0	- The price delivered to the Lebanese border is assumed to be the equivalent to 0.54 times the price of Brent crude oil.
Lebanon	- From 2009	2.5	- Assumes comparable reserve size and costs as the Yam Thetis development in Israel.

Note: The above price estimation of the various gas supply options is based on crude oil price of US$20/barrel.
Source: CEPCO 2004.

2.28 The Lebanese gas market is relatively small and the merit of the construction of a regasification plant and the import of LNG will depend on access to piped gas, the relative costs of piped gas to LNG, and future gas demand in Lebanon.

2.29 At the moment, the current price structure looks in favor of piped gas, not at least because the construction of a regasification terminal would add about US$0.79/mmbtu to the LNG costs. In the short term, LNG will not be able to compete with the current gas price contract with Syria, and despite recent cost reductions caused by improved LNG technologies, it is unlikely that LNG will be able to compete on a cost basis with Egypt or Iraqi gas in the medium term.

2.30 Considering the current contractual arrangements with Syria, negotiations are under way with Egypt against the predicted gas demand forecasts in Lebanon. Construction of an LNG facility, today, would provide a supply that greatly exceeds demand and, therefore, substantially increasing the cost of gas supply and, thus, power production costs. In the early years, these costs could rise possibly even above the current cost of power production.

SECURITY OF GAS SUPPLY

2.31 Security of gas supply and diversification of energy sources is crucial for any country, but in particular for economies such as Lebanon that are entirely dependent on imports to meet its energy needs. Lebanon can mitigate against the risk of gas supply interruptions mainly by (a) diversifying sources of supply, and (b) maintaining dual fuel capability of power plants and other large energy users.

2.32 In the short term, Lebanon will rely on a single source of natural gas from Syria via the GASYLE Pipeline. In the medium term, the construction of the Arab Gas Pipeline will allow Lebanon to diversify its natural gas sources by importing gas from Egypt, once the Arab Gas Pipeline has been built. Once the Iraqi gas network is interconnected with the Mediterranean, Lebanon will have an additional source of supply. In addition, LNG may become a longer-term supply option, once the economics of regasification improve and the Lebanese market can absorb these additional quantities of gas. Nevertheless, for the next few years, Lebanon will rely on single source of gas supply from Syria.[24]

2.33 To mitigate the risk of supply interruptions, power generators can maintain dual fuel capability. CCGT power plants, such as Bedawwi and Zahrani, already have dual fuel capability and can burn natural

[24] Lebanon is no exception in this regard. Many countries around the world rely on a single source and pipeline for gas import, including many transition economies in Eastern Europe; Pakistan; some Australian jurisdictions, such as Victoria and South Australia; and others.

gas or gas oil. It is important that both plants stock adequate quantities of natural gas and/or gas oil to assure continuity of power generation in difficult circumstances, such as gas supply interruptions.

2.34 **Considering the current contractual arrangements and the limited size of the Lebanese gas market, Lebanon should follow a phased approach for the development of gas infrastructure that closely aligns with the increase in gas demand. In the short to medium term, Lebanon should pursue a piped gas strategy focusing on using the existing contractual arrangement with Syria and pursuing regional interconnection with its neighboring countries. Once domestic gas demand outgrows gas supply options from neighboring countries, LNG may become an economic viable alternative source of supply.**

2.35 **To increase security of supply, CCGT power plants should keep a strategic stock of gas oil in case of gas supply interruptions. The Government of Lebanon should further investigate appropriate measures to mitigate the risk of supply interruptions, including assessing storage requirement for power generators.**

3. The Petroleum Sector and Implications from Increased Gas Demand

3.1 The introduction of natural gas to Lebanon is likely to have a significant impact on the petroleum market, particularly the demand for fuel and gas oil displaced by the natural gas. Concurrently, a review of the oil market in Lebanon reveals significant opportunity for efficiency improvements through restructuring and introducing efficient competition in the sector. This section will (a) provide an overview of the market for oil products in Lebanon; and (b) discuss the current market and pricing structure.

THE MARKET FOR OIL PRODUCTS

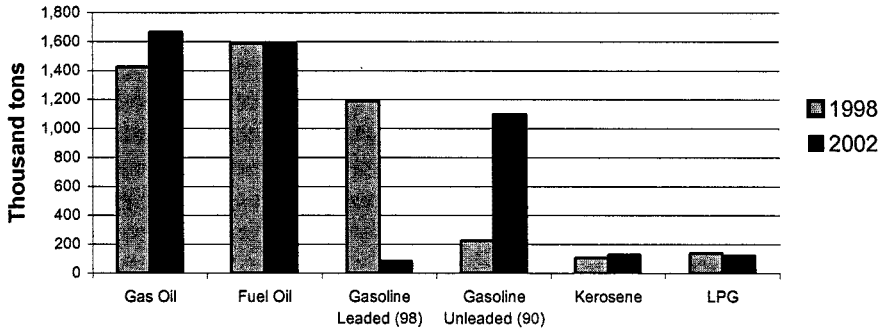
3.2 Today, about 98 percent of Lebanese energy demand is covered by oil products (gas oil, fuel oil, leaded and unleaded gasoline, kerosene, LPG, and other products). In 2002, Lebanon imported 4.67 million tons of refined oil products.

3.3 Oil product imports have a major impact on the Lebanese trade and current account balances, and absorb about 60 percent of annual revenues earned from merchandise exports and tourism. In 2002, fuel and gas oil purchasing costs accounted for about 67 percent of EdL's annual expenditures. In addition, Lebanon's oil product import bill is highly volatile and subject to changes in international oil and subsequent refined oil product prices, reaching about US$720 million in 2002.

3.4 There are two non-operational crude oil pipelines crossing Lebanon, one coming from Saudi Arabia and the other from Iraq. The two existing oil refineries located in Zahrani and Tripoli are out of operation since the late 1980s, and consequently Lebanon relies on the import of refined oil products to meet industrial, commercial, and domestic energy demand.

3.5 Figure 3.1 below provides an overview of oil product imports in 1998 and 2002. Gas oil, fuel oil, kerosene, and LPG volumes stayed relatively stable over the last few years. In 2002, Lebanon imported about 1.7 million tons of gas oil, 1.6 million tons of fuel oil, 1.1 million tons of unleaded gas, and about 120,000 tons of kerosene and LPG. Major changes only occurred to gasoline when the government decided to phase out leaded gasoline to reduce air pollution. In 1998, leaded gasoline imports were 1.2 million tons compared with unleaded gasoline imports of 220 thousand tons. Today, leaded gasoline has been substituted almost fully by unleaded gasoline and coves 93 percent of the Lebanese gasoline market.

Figure 3.1. Lebanese Oil Product Imports, 1998 and 2002 (in '000 tons)



Note: LPG = liquefied petroleum gas.
Source: The Petroleum Directorate, Lebanon, 2003.

OIL MARKET STRUCTURE AND PETROLEUM PRICING

3.6 Until 1987, the Lebanese government was the sole importer of crude oil and refined oil products. The Zahrani and Tripoli refineries, which are owned by the state-owned Oil Installation Company, continue to import gas and fuel oil for power stations and some industrial users. In addition, there are currently eight private companies that import oil products, including gasoline and kerosene to the local market.[25]

3.7 The two refineries also own and operate storage facilities and terminals. Some private companies also operate storage facilities, especially for fuel, gas oil, and gasoline. The import of LPG continues to be controlled fully by a monopoly importer who also controls all available LPG storage facilities.

3.8 Distribution of oil products within the country is handled by about 40 companies, and there are some 2,100 service stations throughout Lebanon.

3.9 Despite the relatively large number of companies operating in the import and distribution of oil products, the current market structure does not encourage efficient competition among the companies. The lack of open access to terminals and oil products storage facilities in Lebanon hinders the development of efficient competition in the market. This is illustrated in the LPG sector, where import, storage, and distribution are monopolized by a single company.

3.10 Table 3.1 provides an overview of the characteristics of the current market structure for oil products in Lebanon, an indication of the number of companies in each market segment, the process for determination of prices, and an assessment of the efficiency of the existing arrangements.

[25] Private importers of petroleum products include Wardieh Holding Inc., Total Liban, Coral Oil Company, Medco, Gaz Orient, Hypco, Falcon, and Cogico.

Table 3.1. Current Market Structure for Oil Products in Lebanon

	Import	Storage	Distribution/ Retail	Administered Prices	Efficient Competition
Fuel Oil	multiple	multiple	multiple	yes	no
Gas Oil	multiple	multiple	multiple	yes	no
Gasoline	multiple	multiple	multiple	yes	no
Kerosene	multiple	multiple	multiple	yes	no
LPG	single	single	single	yes	no

Source: The World Bank 2004.

3.11 The MEW has the sole responsibility for setting and regulating retail prices for all oil products, which are published weekly by the ministry. The government's administered prices are based on average oil product prices in the Mediterranean over the previous four-week period. MEW constantly monitors price developments in the major markets for petroleum imports to Lebanon and carries out periodic price adjustments to reflect changes in international oil prices, cost of importation, and distribution costs. Table 3.2 below sets out the typical retail price structure for oil products in Lebanon.

Table 3.2. The Structure of Oil Products Prices

	Import cost
+	Government import duty
+	Fixed distribution margin
+	Transportation cost
+	Gas station fee
+	10 percent value added tax
=	**Retail Price for Oil Products**

Source: The Petroleum Directorate, Lebanon, 2003.

3.12 Oil product import costs comprise Cost, Insurance, Freight (CIF);[26] port handling and storage fees; quality and quantity inspections; and a profit margin for the importer. The profit margin for the importer is about 1 percent of CIF for all oil products except LPG. In November 2003, the total import cost was US$200/ton for fuel oil, US$299/ton for gas oil, US$347.5/ton for gasoline (98 Ron), and US$310/ton for kerosene. The import margin for LPG is much higher than for other oil products and, in November 2003, total import costs for LPG were approximately US$665/ton.

3.13 A government import duty of US$446/ton was levied on gasoline. All other imported oil products were exempt of import duty. A fixed distribution margin is added, regardless of actual distribution costs to ensure a minimum income level for distributors/retailers. In November 2003, the distribution margin was US$13.4/ton for gasoline products, US$5.6/ton for kerosene and gas oil, and US$50/ton for LPG. There was no distribution fee levied on fuel oil. A transportation fee (that is, a trucking fee) in the range of US$6–7.2/ton was added for fuel oil and gasoline in November 2003. No transportation fee was levied on LPG.

3.14 The calculation of gas station fees is unclear and nontransparent and appears to be negotiated between the MEW, oil importers, distributors/retailers, and industry representatives. In November 2003, gas station fees for gasoline were US$71.5/ton, and about US$14–16/ton for other oil products. LPG is not subject to gas station fees and is distributed through LPG filling centers. A value added tax (VAT) of 10 percent is applicable to all oil products, levied on the total delivered cost to final consumers, and

[26] CIF is a trade term requiring the seller of oil products to arrange for the carriage of goods by sea to a port of destination, and provide the buyer with the documents necessary to obtain the goods from the carrier.

included in the final retail price. Table 3.3 provides the pricing structure of various oil products in Lebanon in 2003 and shows the relatively high taxes on gasoline and distribution and profit margins for LPG.

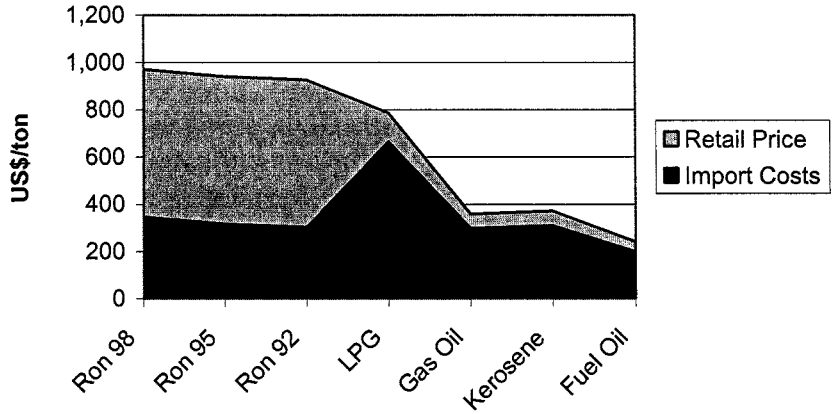
Table 3.3. Price Structure for Petroleum Products, November 2003 (in US$/ton)

	98 Ron	95 Ron	92 Ron	Fuel Oil	Gas Oil	LPG	Kerosene
Import Costs	347.5	317.6	303.8	200.0	299.0	665.2	310.0
Government Duty	446.0	446.0	446.0	—	—	—	—
Distribution Margin	13.4	13.4	13.4	—	5.6	50.0	5.6
Transport Fee	7.2	7.2	7.2	6.0	6.4	—	6.4
Gas Station Fee	71.5	71.5	71.5	14.0	16.0	—	16.0
Total Costs	885.6	855.7	841.8	220.0	327.0	715.2	338.0
10% VAT	88.6	85.6	84.2	22.0	32.7	71.5	33.8
Retail Price	974.2	941.3	926.0	242.0	359.7	786.7	371.8

— Not available.
Note: VAT = value added tax; EN590 is jet fuel; 98 Ron, 95 Ron, and 92 Ron are unleaded gasoline.
Source: The Petroleum Directorate, Lebanon, 2003.

3.15 Figure 3.2 below provides a graphic overview of oil product retail prices compared with import costs in Lebanon in November 2003. It shows that the retail tariff of gasoline products are relatively high compared with total import costs, reflecting relatively high gas station fees, distribution allowances, or government duties on these products. The retail price/import cost ratio for LPG, fuel and gas oil, and kerosene are relatively low, indicating lower fees and taxes.

Figure 3.2. Comparison of Retail Prices and Import Costs for Petroleum Products
(As of November 19, 2003)



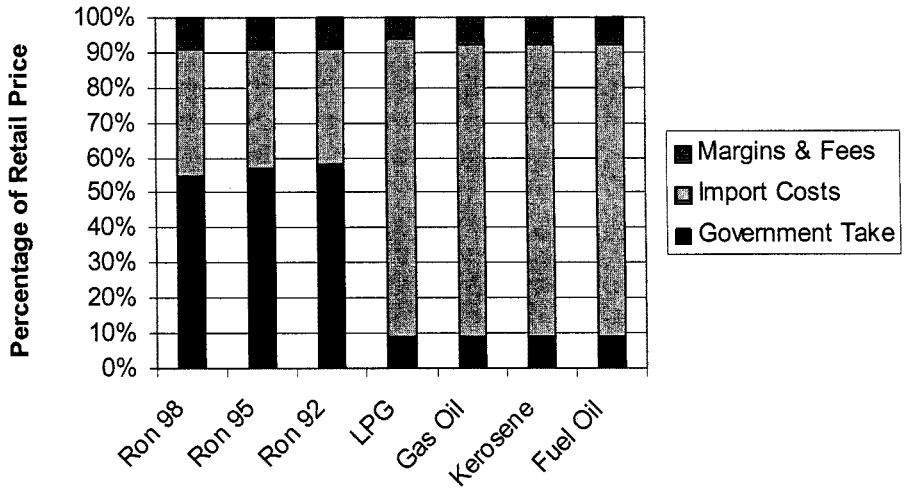
Note: LPG = liquefied petroleum gas.
Source: The Petroleum Directorate, Lebanon, 2003.

3.16 In 2002, the Ministry of Finance estimated that the total net revenue realized from government duty and VAT amounted to US$836 million, of which the contribution from taxes levied on gasoline was US$715 million or 85 percent. Government revenues from taxing oil products account for about 20–30 percent of total annual revenues.

3.17 Figure 3.3 below gives a comparison of the government take on oil product taxes (including government duty and VAT) with import costs for the various oil products in Lebanon. It indicates that

gasoline products are taxed highly compared with fuel and gas oil and LPG in Lebanon and provide a major source of income for the government. Government take (import duty and VAT) accounted for between 55 and 58 percent of the final retail price for the various gasoline products, and 9 percent for gas and fuel oil, LPG, and kerosene. Distribution margins were between 6 and 9 percent of the final retail price in November 2003.

Figure 3.3. Comparison of Import Costs and Government Take on Oil Products
(As of November 19, 2003)



Note: LPG = liquefied petroleum gas.
Source: The Petroleum Directorate, Lebanon, 2003.

3.18 Government import duty taxes and VAT on oil products are major sources of revenue for the Lebanese Government, who is highly dependent on revenues from taxing oil products. Lebanon has adopted the same approach as other countries to levy taxes on petroleum products, particularly gasoline, because of the relatively low responsiveness of the demand to price changes.[27] High taxes on gasoline may also encourage customers to switch to gas oil in sectors where gasoline can be substituted (for example, for automobiles). At the same time, efforts should be made to widen the sources of government revenue to relieve the high levels of petroleum taxes and help the competitiveness of Lebanese industries and services.[28]

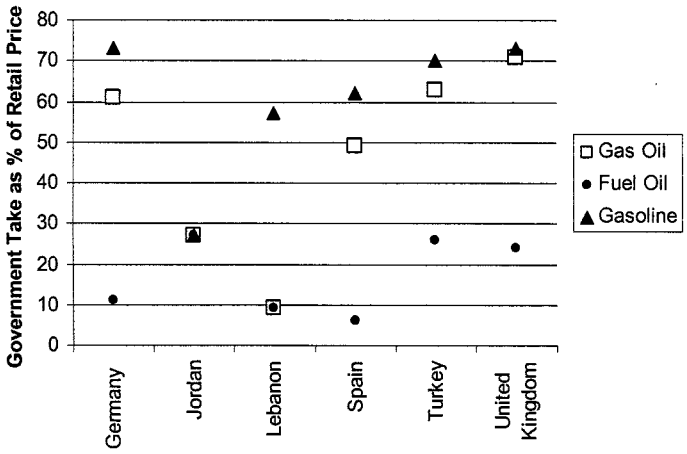
3.19 By regional standards, taxes on oil products in Lebanon appear to be relatively high but are similar to other oil import-dependent middle-income countries, such as Jordan. The current level of government take/retail price ratios on oil products is comparable with high-income countries in Western Europe. This is indicated by Figure 3.4, which shows that government take on various oil products is comparable with Germany, the United Kingdom, and Spain. The exception is gas oil (diesel) where the

[27] Economic theory of taxation states that taxes can be increased on products and services that have no immediate substitutes, and for which the demand is relatively insensitive to price changes, or have inelastic demand.

[28] For a detailed discussion on international trends on fuel taxes and their implications refer to "ViewPoint, Petroleum Taxes, Trends in Fuel Taxes (and Subsidies) and the Implications" by Robert Bacon, Oil and Gas Policy Division, World Bank. Available at www.worldbank.org. (September 2001, Viewpoint #240)

Lebanese government only charges a 10 percent VAT and no government duty. In comparison, Western European countries tax gas oil at between 50 and 70 percent of the retail price, and Jordan taxes it at about 30 percent. Increasing taxes on diesel in line with international best practice may provide the Lebanese Government with additional sources of income without distorting the efficiency in the market (assuming a relatively low price elasticity of diesel oil).[29]

Figure 3.4. International Comparison of Government Take on Oil Products, 2003



Source: International Energy Agency (IEA) 2003.

3.20 Lebanon currently has 9 importers and about 40 oil product distributors. This is a large number of companies compared with the size of the oil products market. In addition, the government continues to be involved in all aspects of the oil products chain. Despite having numerous importers and distributors for oil products (except for LPG), no efficient competition exists. Prices for oil products are administered by the government and are not determined by market forces, and importers and distributors earn fixed import and distribution margins.

3.21 Distributors are allowed to charge relatively high and fixed distribution margins, in particular for gasoline. It is estimated that the retail margin allowance for gasoline is approximately 30 percent, which is much higher than the international norm of 8 to 15 percent. The calculation of gas station fees remains unclear and margins are relatively high, providing significant windfall gains for importers and distributors.

3.22 Under a fixed and administered pricing regime, competition cannot evolve with all its negative effects on efficiency and final prices. The shortcoming of the current pricing regime is best reflected in the case of LPG, where the government does not levy any government tax for social reasons and only charges a 10 percent VAT. However, high fixed distribution and import margins make LPG relatively expensive and less affordable for households, in particular poorer customers. In November 2003, LPG retail prices in Lebanon were US$786.7/ton. As a comparison, retail prices in Jordan and Egypt for LPG

[29] Higher tax for petroleum products in Lebanon compared with neighboring countries may encourage smuggling of certain oil products. For a more detailed discussion refer to "ViewPoint, Abuses in Fuel Markets and How to Protect Consumers and Public Health" by Masami Kojima and Robert Bacon, Oil and Gas Policy Division, World Bank. Available on www.worldbank.org. (September 2001, Viewpoint #237).

were US$270/ton and US$285/ton over the same time period, respectively.[30] The main reason for the high LPG prices seem to be caused by the extremely high import costs, which include CIF, port handling, storage fees, and the profit margin for importer.

3.23 Table 3.4 below provides and overview of international LPG prices for 2001, 2002, and the first two quarters of 2003. The contract and CIF prices do not include port handling and storage fees, profits margins for importers, and other fees. This will have to be added to arrive at the total import costs. In November 2003, total import costs for LPG in Lebanon were about US$665/ton. Compared with the international contracts and CIF prices for LPG, the margin for storage and handling fees and the importer margin in Lebanon seem inordinately high.

Table 3.4. International LPG Prices, 2001–2003

(US$/ton, quarterly average)

	Propane					Butane				
	Saudi Arabia Contract (1)	Japan Spot CIF (3)	UK N. Sea Contract (2)	NEW Spot CIF (3)	USGC Spot CIF (3)	Saudi Arabia Contract (1)	Japan Spot CIF (3)	UK N. Sea Contract (2)	NEW Spot CIF (3)	USGC Spot CIF (3)
2001 1Q	338	358	300	298	324	310	330	270	266	291
2001 2Q	278	301	252	260	251	235	252	217	230	225
2001 3Q	247	249	202	218	206	220	233	175	197	200
2001 4Q	228	224	173	185	170	224	221	178	191	158
2002 1Q	221	229	185	202	163	190	196	158	193	151
2002 2Q	223	242	196	212	200	203	229	188	198	181
2002 3Q	240	277	209	234	211	232	271	196	235	209
2002 4Q	316	349	260	298	245	316	349	274	294	247
2003 1Q	367	388	366	365	341	353	370	301	319	318
2003 2Q	268	280	217	236	264	252	276	186	206	230

Note: CIF = Cost, Insurance, Freight. The chemical composition of LPG can very, but it is usually made up of predominantly propane and butane. LPG sold can range from virtually pure propane to pure butane.
(1) New Contract Price method w.e.f. October 1994; (2) BP prices; (3) Spot/CIF/CFR quotations refer to large cargo movements to Japan, North West Europe, and U.S. Gulf Coast.
Source: World LP Gas Association. 2003. *Statistical Review of Global LP Gas.*

3.24 **To increase efficiency and transparency, the Government of Lebanon should restructure the oil products market and reforms the pricing regime to allow for (a) efficient competition in the importation and distribution of oil products to develop; and (b) the provision of fair and open access to storage facilities, as well as the introduction of competition in the import and distribution of LPG. In addition, the Government of Lebanon should gradually reduce its role in the sector, and focus on regulating quality and safety standards for oil products and creating safety nets for vulnerable customer groups in the transition to more efficient market and pricing structures. This would benefit customers through lower prices and better service, improve the allocation of energy within the economy, and allow the government to maximize tax revenues.**

[30] Note that Egypt and Jordan liquefied petroleum gas (LPG) retail prices do not necessarily reflect the economic costs of importing and distributing LPG and may be subsidized for social reasons.

4. The Potential for a Refinery in Lebanon

4.1 Lebanon has two refinery installations, one located in Zahrani, in the south of the country, with a capacity of 17,500 barrels per day (b/d) and one located in Tripoli, in the north, with a capacity of 35,000 b/d. Military conflicts caused both refineries to cease operation in 1989 and 1992, respectively, and currently both plants are used only as import terminals and storage facilities for refined oil products.

4.2 A recent technical and economic feasibility study on both refineries[31] concluded that the rehabilitation and modernization of the Tripoli and Zahrani refineries are not viable because of the following:

- Existing process units are too obsolete and do not meet the current specification of petroleum products;
- The capacity of the refineries is relatively small and the efficiency comparatively low; and
- Rehabilitation costs are almost the same as the construction costs for a new refinery.[32]

4.3 The economics for a new refinery in Lebanon are driven by domestic demand conditions and the characteristics of the international refinery market and, in particular, the immediate region as a potential source of import of oil products. These issues will be discussed in more detail in the following sections.

DEMAND FORECAST FOR PETROLEUM PRODUCTS

4.4 The Lebanese market for refined oil products is relatively small, and the country is entirely dependent on imports. In 2002, Lebanon imported about 4.7 million tons of refined oil products (94,000 b/d).[33] With the introduction of natural gas for power generation, demand for certain oil products is expected to decrease over the coming years, in particular for heavy distillates such as fuel oil. The growth in the demand for petroleum products, particularly gasoline, is likely to be strongest in the transport sector.

4.5 Table 4.1 below provides demand forecasts for petroleum products in Lebanon for 2015 under two different scenarios. Scenario A is based on the assumption of a full conversion of all existing power plants to natural gas, except the Zouk plant, which will continue to run on fuel oil. Scenario B estimates future consumption on the basis of full conversion of all power plants to natural gas by 2015. The figures show that under scenario B demand for fuel oil will fall dramatically over the next decade because of the replacement of this fuel by natural gas for power generation.

4.6 It is predicted that gasoline and kerosene demand will double over the same period from about 1.2 and 0.12 million tons in 2000 to about 2.5 and 0.26 million tons in 2015, respectively. Gas oil demand is expected to increase to about 1.5 million tons by 2015 (under both scenarios) and fuel oil consumption will either decrease from the current level of 1.5 million tons to 0.4 million tons (scenario B) or remain at the same level (scenario A).

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[31] Chubu Electric Power Company Ltd. (CEPCO). January 2004. "Preliminary Feasibility Studies of Refineries."

[32] It has been estimated that the rehabilitation costs for the same capacity and specification of the Tripoli refinery is between US$150–200 million. Rehabilitation costs for the 17,500 barrels per day (b/d) Zahrani refinery is estimated at about US$35 million (CEPCO 2004).

[33] One million tons of oil per year is equivalent to 20,000 b/d.

Table 4.1. Demand Forecast for Petroleum Products, 2015 (in '000 tons)

Sector	Year	Fuel Oil	Gas Oil	Kerosene	Gasoline	Other	Total
Power	2000	1,294	532	—	—	—	1,826
	2015 (A)	1,106	92	—	—	—	1,198
	2015 (B)	—	—	—	—	—	—
Industry	2000	213	368	—	—	—	581
	2015 (A)	400	700	—	—	—	1,100
	2015 (B)	400	700	—	—	—	1,100
Transport	2000	—	16	125	1,264	—	1,405
	2015 (A)	—	30	250	2,500	—	2,780
	2015 (B)	—	30	250	2,500	—	2,780
Other	2000	—	399	4	—	260	663
	2015 (A)	—	800	10	—	500	1,310
	2015 (B)	—	800	10	—	500	1,310
Total	**2000**	**1,507**	**1,315**	**129**	**1,264**	**260**	**4,475**
	2015 (A)	**1,506**	**1,622**	**260**	**2,500**	**500**	**6,388**
	2015 (B)	**400**	**1,530**	**260**	**2,500**	**500**	**5,190**

— Not available.
Note: The supply/demand figures for 2000 are based on the 2002 Energy Statistics of non-OECD countries published by the IEA.
Source: CEPCO 2004.

4.7 Over the last few years, annual demand for petroleum products in Lebanon has been fluctuating between 4.5 and 4.8 million tons/year (90,000–96,000 b/d) and reached 4.5 million tons in 2000. Total demand for petroleum products is estimated to increase to 6.4 million tons (128,000 b/d) under scenario A or around 5.2 million tons (104,000 b/d) under scenario B by 2015.

SUPPLY OF PETROLEUM PRODUCTS

4.8 The potential for a refinery in Lebanon also has to be evaluated considering the supply and demand conditions for petroleum products in the Mediterranean region. The market for refined oil products in the region is competitive, with five countries (namely Egypt, Syria, Libya, Saudi Arabia, and Turkey) located in the geographic vicinity of Lebanon that have substantial refining and export capacities. Spare refining capacity in the region will ensure that Lebanon has access to oil products at competitive prices from different sources in the medium to long term.

4.9 An overview of refinery and export capacities in 2000 in the immediate region is outlined in Table 4.2 below. It shows that there was substantial export capacity for oil products available in the East Mediterranean region in 2000. Since then, new refinery capacity has been planned for or constructed in the region that further increased the export capacity of most countries in the region.

Table 4.2. Refining and Export Capacity in the Mediterranean Region, 2000
('000 tons/year)

Country	Refining Capacity					Export Capacity				
	Crude Oil	Gaso-line	Gas Oil	Fuel Oil	Other Products	Crude Oil	Gaso-line	Gas Oil	Fuel Oil	Other Products
Egypt	34,807	2,261	5,759	11,171	6,238	7,779	—	203	3,821	3,316
Syria	27,337	1,579	4,061	5,200	1,284	14,629	332	—	952	127
Libya	65,318	2,030	4,662	4,330	3,259	48,418	113	2,407	1,542	2,810
S.Arabia	410,595	12,586	23,939	24,616	16,063	319,957	2,808	5,991	15,791	11,466
Turkey	3,233	3,677	7,969	8,213	6,835	—	—	1,095	563	417

— Not available.
Source: CECPO 2004.

4.10 In Egypt, a new and modern 100,000 b/d refinery (Midor refinery)[34] came on stream at Sidi Krir in April 2001, boosting Egypt's total refining capacity to 704,000 b/d (35 million tons/year). Although the seven existing refineries already had sufficient capacity to meet domestic demand, they produce a large surplus of fuel oil, earmarked for export.

4.11 Syria has two refineries at Homs and Banias with capacities of 107,140 b/d and 135,000 b/d, respectively. The Syrian government is planning to upgrade its two existing refineries and increase their production of gas oil and other light products. At present, some 44 percent of the total refinery output of 242,140 b/d (12 million tons/year) consists of fuel oil, while gas oil accounts for around 35 percent and gasoline for less than 12 percent. As a result, the refineries produce a surplus of more than 1 million tons/year of fuel oil, gasoline, and naphtha, which is mostly exported.

4.12 The Libyan National Oil Corporation (NOC) operates five oil refineries with a combined capacity of 380,000 b/d (19 million tons/year refining capacity). NOC has a refinery development program that includes rehabilitation, revamping, and modernization. If it is carried out as planned, the refineries will produce substantial surpluses not only of gasoline (more than 3.1 million tons/year) and gas oil (1.9 million tons/year), but also of jet fuel (870,000 tons/year) and fuel oil (530,000 tons/year). The refineries in Libya can produce a surplus of all kinds of petroleum products, and export the same quantity as that of the domestic demand.

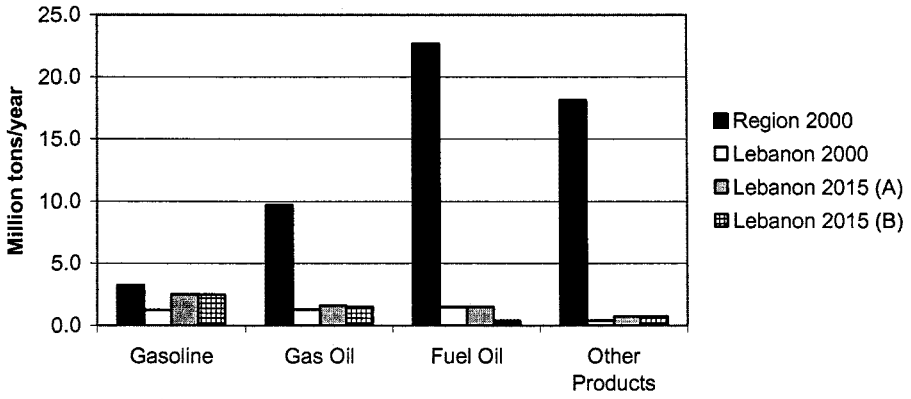
4.13 Saudi Arabia has eight refineries with a total capacity of 1,820,000 b/d (91 million tons/year), including two export-oriented refineries operated by independent joint ventures in Yanbu (with Mobil) and Jubail (with Shell) that have capacities of 365,000 b/d (18 million tons/year) and 305,000 b/d (15 million tons/year), respectively.

4.14 Turkey has five oil refineries with a combined capacity of 688,000 b/d (34 million tons/year). Turkey Petroleum Refinery Corp., Turkey's largest refiner, is planning to invest in six projects to produce fuels that meet European Union standards. This would mainly increase output of premium gasoline and other light products that are currently imported.

4.15 Figure 4.1 below compares the total export capacity of oil products from refineries in Egypt, Syria, Libya, Saudi Arabia, and Turkey in 2000 with the various Lebanese demand scenarios for 2000 and 2015 (scenario A and B). It shows that there is plenty of spare capacity in the refinery market in the region for gasoline, fuel and gas oil, and other refined oil products.

[34] The Midor refinery was the first plant in the Middle East to comply with new European Union environmental standards. This compliance has shifted the Egyptian refining industry's output toward the lighter end of the product slate.

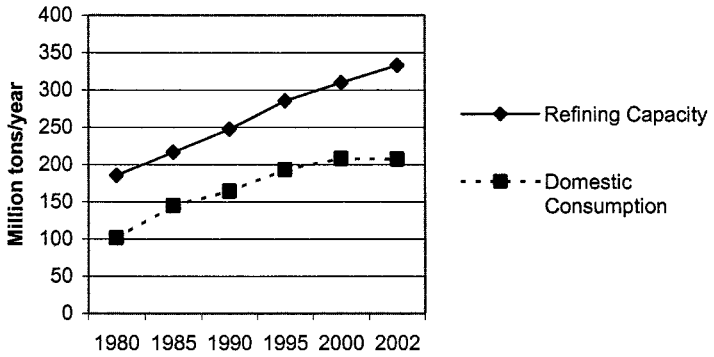
Figure 4.1. Export Capacity of Refineries in Region and Lebanese Demand



Note: Region includes Egypt, Syria, Libya, Saudi Arabia, and Turkey; Other Products Include kerosene, LPG, and others.
Source: World Bank table based on data from CEPCO 2003.

4.16 Figure 4.2 provides an overview of domestic demand and refining capacity in the Middle East since 1980. The Middle East includes Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates, and other countries in the region. It shows that there is substantial refining capacity available in the Middle East, which has further increased in the period 2000 to 2002. It is estimated that total export capacity of the Middle Eastern countries exceeds 100 million tons/year.

Figure 4.2. Refining Capacity and Domestic Demand in Middle East



Source: British Petroleum Statistical Review 2003.

FEASIBILITY OF A NEW OIL REFINERY IN LEBANON

4.17 Lebanon is currently assessing the economics for the construction of a new oil refinery. In 2000, the MEW planned the construction of a grassroots 150,000 b/d (7.5 million tons/year) refinery in Tripoli under the terms of a build-operate-transfer (BOT) contract, and these plans are still pending.

4.18 As mentioned earlier, there are currently two crude oil pipelines crossing Lebanon, one coming from Saudi Arabia and the other from Iraq via Syria. There are plans for reopening the Iraqi-Syrian crude oil pipeline and for rehabilitating the 50 km section stretching from Homs (in Syria) to Tripoli (in Lebanon). The Lebanese Government will need to examine the condition of the pipeline from Homs in

Syria to Tripoli and the feasibility of returning it to operation. The rehabilitation would provide a significant potential for crude oil export from Iraq to a potential refinery in Lebanon.[35] There seems to be an opportunity for the Lebanese government to start a dialogue with Syria and Iraq to explore that potential.[36] The optimal capacity of a modern refinery for Lebanon is estimated to be 100,000 b/d and would cost approximately US$670 million.[37] Domestic demand forecasts for LPG, gas oil, kerosene, and gasoline in the near future are relatively high and could be satisfied with the supply from a new refinery in Lebanon. Future demand for petroleum products has been estimated between 104,000 b/d and 130,000 b/d by 2015.

4.19 Although there is a market for refined products in Lebanon, it is not obvious that a domestic refinery would be the most competitive means to meet the market demand. The economics for building a new refinery in Lebanon in the short term look challenging because of the following:

- Lebanon does not have indigenous oil reserves and, without its own source of crude oil, it will be fully dependent on the import of crude oil at prices determined on international petroleum markets. This will deprive the country from any comparative advantage of supplying a local refinery with relatively cheap crude oil.
- Any new refinery in Lebanon will produce fuel oil and other oil products that have to find a domestic and international market. There seems to be a limited market potential to export fuel oil and other oil products that are not used locally, considering the excess capacity in the region.[38]
- International petroleum product markets are highly competitive, and there are multiple sources of supply to cover the demand for oil products in Lebanon.
- Finally, considering the dependence on crude oil imports for operating a domestic refinery, it is unlikely that the construction of a new refinery will increase the security of energy supply of Lebanon, the key objective for the MEW for constructing the refinery.

4.20 In the longer term, the resumption of exports from Iraq and the availability of crude oil from other locations in the Middle East could substantially improve the potential for a new refinery in Lebanon. Crude oil may become available at an attractive price, and the economics of a refinery located at the export end of a crude oil export route look comparatively better than a refinery that depends on marine imports.

4.21 **The decision of whether, and when, to enter the refining market in Lebanon will have to be assessed by the private sector, which will have to finance such a construction and take on the commercial risk of operation. The Government should not engage directly in the financing, ownership, and operation of a new refinery in Lebanon, but should act as a business developer only to facilitate investment.**

[35] This export route could potentially replace some of the Iraqi exports through Turkey and avoid the congestion of the Marmara Strait in the Black Sea.

[36] At the same time, the potential for Saudi crude oil exports through Zahrani via the Golan Heights on the Israel/Lebanon borders is less likely and would depend on a wider political settlement in the region.

[37] CEPCO 2004.

[38] The proposed substitution of fuel oil by gas means that the refinery has to have enhanced conversion capability to reduce output of fuel oil.

5. The Gas Market Structure

GOVERNMENT OBJECTIVE

5.1 The structure of the gas market has major implications on the attractiveness for private investors to participate in the market and provide capital.[39] The Lebanese gas market is at an early stage of development and the country has a unique opportunity to put in place a market structure that will attract private investors and will allow for efficient gas and interfuel competition to develop.

5.2 The Government of Lebanon set out its key objectives for the sector in a recently published document that focuses on the following:[40]

- Encouraging competition in the gas sector;
- Promoting customer choice and safeguard health and safety;
- Establishing an efficient legal and regulatory framework;
- Implementing efficient pricing regimes that allow companies to charge tariffs that reflect prudently incurred costs;
- Allowing for private participation in all parts of the gas chain;
- Monitoring and encouraging performance improvements of state-owned industries; and
- Promoting energy efficiency and environmental issues.

5.3 The gas market in Lebanon initially will be small. However, there is strong potential in Lebanon for increased gas usage and supply sources, but that depends on the development of domestic gas networks and interconnection to regional networks.

5.4 This section is structured as follows: (a) overview of initial gas market structure in Lebanon under the GASYLE Pipeline; (b) discussion on the impact of the construction of the proposed National Pipeline; (c) detailed discussion on key principles for establishing a competitive market; and (d) overview of envisaged future market structure.

5.5 Section 6 presents the recommended legal and regulatory framework for implementing the proposed market structure and key market principles. It is important to stress that the recommended market structure and policies to achieve competition take a longer-term view and assume that gas demand will outgrow the supply available from the current agreement with Syria. While the proposed structure may seem sophisticated for a single pipeline running from Homs to Bedawwi, the potential construction of the National Pipeline (and other future networks) will increase the number of players in the market. This increase will require the establishment of a market structure that allows competition to develop and is in accordance with the government's vision of a future competitive energy market in Lebanon.

INITIAL MARKET STRUCTURE

5.6 The gas chain generally consists of four key activities, namely (a) domestic gas production and import, (b) transmission and distribution, (c) shipping and supply, and (d) gas consumption.

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[39] In this context, the World Bank has recently published a paper on the "Public and Private Sector Roles in the Supply of Gas Services: Operational Guidelines for World Bank Group Staff," by Franz Gerner and Bent Svensson, April 2004.

[40] MEW, Lebanese Republic. October 2003. "The Role of Natural Gas in EdL Power Plants."

Domestic Gas Production and Import

5.7 There are no existing on- or offshore gas production facilities in Lebanon. Although primary results indicate that there may be some interesting leads, Lebanon will continue to depend heavily on natural gas imports for the foreseeable future. A gas importer is an entity that buys natural gas upstream from a producer and sells it to shippers or suppliers in the downstream market. When the GASYLE Pipeline is completed, the MEW will initially be the sole gas importer.[41]

Transmission and Distribution

5.8 Lebanon is in the process of building its initial gas infrastructure, a 32 km transmission pipeline from Syria (GASYLE Pipeline). The pipeline is expected to be operational in the second half of 2004.

5.9 There are currently no plans to build a distribution network. However, it is envisaged that the development of a transmission network can potentially lead to a market that can supply residential customers through a distribution network in the future, especially in the Beirut area.

Shipping and Supply

5.10 A gas shipper is an entity that arranges with the gas transporter for the conveyance of gas on the transporter's pipeline network. Gas supply means activities relating to the purchase of gas from a producer, gas importer or shipper, and sale of that gas to end-users.[42]

5.11 There are currently no independent shippers or suppliers operating in Lebanon, but it is envisaged that those activities will emerge in a restructured and liberalized gas market. Under the current arrangements, MEW is the sole shipper and supplier of gas, given that initially the Bedawwi power station is the only gas customer. To date, there is only one contractual arrangement in place, namely the gas import agreement between MEW and the Government of Syria. There are no contracts in place between the MEW and EdL (the owner of Bedawwi power station) either for the supply of gas or between the Oil Installation Company and EdL for the gas transportation services.

Gas Consumption

5.12 Future gas consumption in Lebanon will be driven by a few "anchor" customers, mainly the electricity generators.

5.13 Under the contractual arrangements that are in place for the GASYLE Pipeline, the Lebanese gas market will be fully vertically integrated and government owned, with MEW acting as the single buyer (sole gas importer) and seller (sole shipper and supplier), network owner and operator (through Oil Installation Company), and consumer (through the state-owned EdL). Figure 5.1 below provides a graphic overview of the gas market players and current structure in Lebanon once the GASYLE Pipeline is operational.

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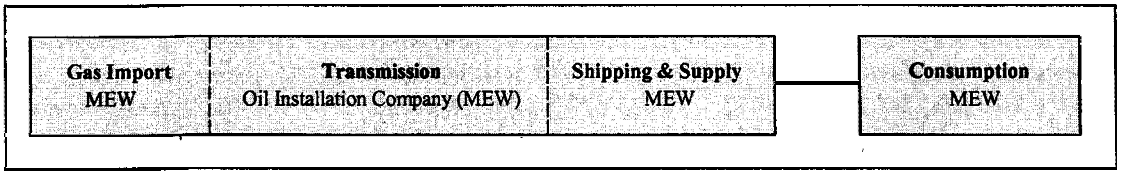
[41] The gas supply contract was signed between PSC and the MEW in December 2001.

[42] In principle, a supplier should be able to buy natural gas directly from a gas importer or shipper. A supplier could buy gas directly from a producer, arrange for shipment through pipeline network, and sell it to final customers. Under such a scenario a supplier would, by definition, also be a shipper.

Figure 5.1. Gas Market Structure for the GASYLE Pipeline



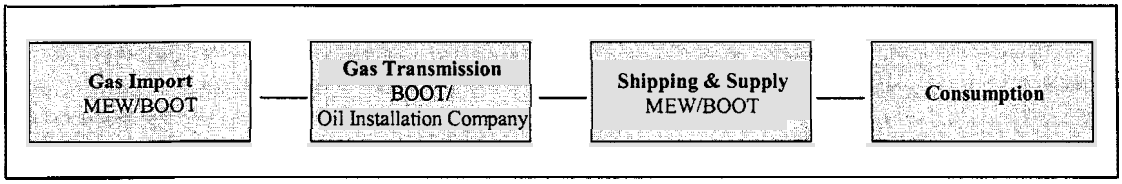
Note: MEW = Ministry of Energy and Water.
Source: World Bank, 2004

THE NATIONAL PIPELINE AND GAS MARKET REFORM

5.14 The Lebanese Government is currently considering an extension of the GASYLE Pipeline from the north to the south (about 130 km) to allow for gas to be supplied to the several power plants along the coast and potentially to non-power sector consumers. It is envisaged that the construction of this pipeline (the National Pipeline) will be carried out by a private investor on a build-own-operate-transfer (BOOT) basis.[43]

5.15 Figure 5.2 below provides a graphic overview of the gas market structure as it is currently envisaged by the government after both the GASYLE Pipeline and the National Pipeline have been constructed and interconnected.

Figure 5.2. Envisaged Market Structure with GASYLE and National Pipelines



Note: MEW = Ministry of Energy and Water; BOOT = build-own-operate-transfer; EdL = Electricité du Liban.
Source: World Bank, 2004.

5.16 At this stage, decisions remain to be taken regarding whether the National Pipeline will be constructed, who is going to own and operate the pipeline network in Lebanon, and who will be involved in the import and supply of gas. Therefore, there are no contracts in place for any of these aspects. However, it appears that the government would like to create a market structure that allows competition to develop and attracts private investors into the gas market.

KEY PRINCIPLES FOR ESTABLISHING EFFICIENT GAS MARKET STRUCTURE

5.17 To allow for new entrants into the market, increase efficient private sector participation, and gradually develop competition, the following key principles have to be implemented in the gas market:

- Unbundle competitive activities from monopoly activities
- Separate contractual arrangements

[43] The Government of Lebanon has engaged an adviser to assist in the technical evaluation of this pipeline (including evaluation of on- versus offshore facilities) and to assist in securing a private investor. No contractual arrangements have been signed to date for the construction, operation, and management of the National Pipeline.

- Open access to transportation network

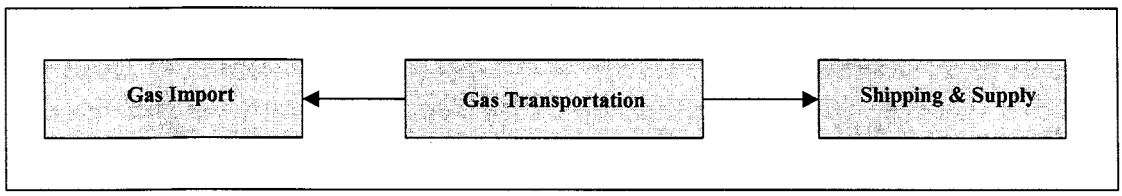
Unbundle Competitive Activities from Monopoly Activities

5.18 To introduce effective competition in the market and encourage private participation, an industry structure that allows gas importers, shippers, and suppliers to compete on a level playing field with each other has to develop. Hence, the introduction of effective competition in the gas sector has to ensure that competition is not undermined by anticompetitive behavior. Potentially, vertically integrated gas businesses, with the incumbent operating in both competitive import and supply businesses and transportation activities, are likely to restrict or slow the development of competition.[44]

5.19 Anticompetitive conduct occurs when the monopoly part of the vertically integrated business (that is, transmission and distribution) behaves in a way that gives its competitive business units (that is, supply and shipping and import) an advantage over its competitors.

5.20 Unbundling[45] seeks to prevent this type of anticompetitive behavior, and can be achieved through the isolation of the monopoly elements of a vertically integrated business from the competitive elements, thereby reducing both incentives and opportunities for anticompetitive conduct (see Figure 5.3 below).

Figure 5.3. Unbundling of Competitive and Monopoly Activities



Source: World Bank, 2004.

5.21 In principle, there are four types of separation or unbundling methods, including the following:

- Financial separation
- Physical separation
- Legal separation
- Ownership separation

5.22 *Financial separation* is effective at the accounting level and requires separate accounts for the monopoly and competitive activities of the gas chain. The major objective of financial separation is to enable the company and the regulator to identify the costs of each business activity and report these costs in a transparent way to avoid cost-shifting[46] among business activities in a more competitive market.

5.23 *Physical separation* is a more stringent form of unbundling. In addition to providing separate accounts, physical separation requires having separate offices in separate buildings, or, if within the same building, by locating offices on separate floors and providing restricted access of staff and restricting

[44] A transporter operating in monopoly and competitive supply and shipping activities is also referred to as a transporter with a "merchant" function. In contrast, a transporter with a "non-merchant" function only focuses on transportation activities.

[45] The term "ring-fencing" is also often used to describe the separation and unbundling of monopoly from competitive activities.

[46] In a competitive market, cost-shifting occurs where a utility attributes the cost of providing its unregulated service to a regulated service. The effect is that the utility is able to provide its unregulated service more cheaply, and consumers of the regulated service must bear higher costs. In addition, the utility gains an unfair advantage over its competitors in the unregulated part of its business.

information sharing. A business unit within a utility that is physically separated is likely to have separate management for that unit.

5.24 *Legal separation* incorporates all the characteristics of financial and physical separation. However, it is a stricter version of physical separation requiring the formation of different, independent business activities. The advantage of this form of separation is that it facilitates a clear audit trail, allows for greater transparency, and promotes independent business activities of the legally separated entity.

5.25 The most stringent form of unbundling involves "divesture" of a network business activity implying a new *ownership* arrangement independent of competitive gas activities. In the Lebanese context, this would require the transfer of ownership of the GASYLE Pipeline to an entity that is prohibited to engage in any competitive gas activity, namely gas import, shipping, and supply.

5.26 **The Government of Lebanon should develop a gas market that will unbundle the monopoly transportation activities (namely the GASYLE Pipeline, and potentially the National Pipeline and any other infrastructure being built in the future) from the potentially competitive gas import, shipping, and supply activities.[47] At a minimum, financial separation (that is, separate accounts) is recommended. This is a prerequisite for economic regulation of monopoly network businesses to work.**

Separate Contractual Arrangements

5.27 Vertical separation of monopoly from competitive gas activities also requires contractual separation of the "commodity" gas from the "activity" of transporting gas on the pipeline network.

5.28 Liberalized gas markets require a clear separation between commodity contracts and transportation contracts. *Commodity contracts* are defined as contracts between parties for the purchase and sale of the commodity natural gas. *Transportation contracts* are contracts for the conveyance of gas on a pipeline network. Without separate contractual arrangements, it is not possible to effectively unbundle the potentially competitive from the natural monopoly element of the gas chain.

5.29 Before introducing competition, vertically integrated gas companies around the world had a tendency to sell natural gas to final consumers at bundled prices, which incorporate the commodity gas and the transportation of gas into a single tariff. As a consequence, customers were unable to distinguish between the cost of the commodity gas and the cost of the transportation service. Separation through contractual arrangements not only allows customers to gain a better understanding of the costs involved in buying and transporting gas, but also forces network owners to operate the transportation business as a separate cost center.[48]

5.30 Figure 5.4 below provides a graphic overview of a contractual separation of commodity and transportation contracts that is necessary for introducing efficient competition.

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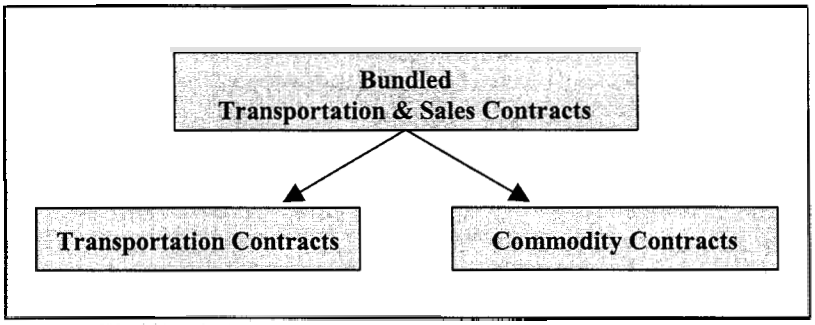
[47] In this context, the Lebanese Law on Regulation of the Electricity Sector states in Article 3 that generation, transmission, and distribution shall be functionally, administratively, and financially independent from one another. However, the law also states that independence should not prevent a company from carrying out more than one of the above activities. This indicates a full ownership separation (i.e., divestment) of generation, and networking is not envisaged at this stage for the Lebanese electricity sector. This is likely to cause a conflict of interest for a network owner, who also operates a generation plant, in the dispatch schedules of the generation plant.

[48] Customers in competitive markets can still purchase both commodity gas and the transportation service from marketers under one contract. A marketer, in this context, is a person who offers a bundled service to a customer but contracts separately for commodity gas and transportation of gas with producers and the transporter.

Figure 5.4. Separation of Contractual Arrangements



Source: World Bank, 2004.

5.31 Currently, there are no requirements in Lebanon to offer separate commodity and transportation contracts in the downstream gas market. EdL does not have a separate transportation contract with the Oil Installation Company for the transport of the gas or a separate commodity contract with MEW for the gas.

5.32 **To enable a competitive market to evolve, separate contracts for transportation and for the commodity gas are recommended. This will not only allow customers to compare gas and transportation tariffs, but will also enable new entrants (such as gas importers, shippers, and suppliers) to arrange for separate transportation contracts to sell gas directly to customers.**

Open Access to Transportation Network

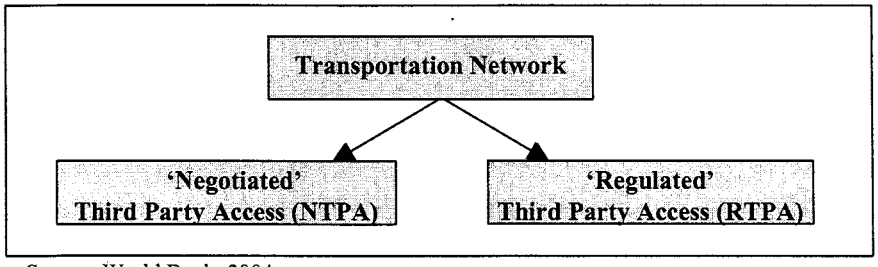
5.33 Without access to the gas transportation network, there cannot be competition in any part of the gas chain. Therefore, open, nondiscriminatory access to the transmission (and distribution) network is a prerequisite for the development of a dynamic downstream gas sector.

5.34 For competition to develop in the import, supply, and shipping of gas, it is paramount that the transporter follows clear and transparent rules of how third parties can access its network. This is of particular importance in markets where transportation is not fully divested from other activities. To achieve competition, access to the gas transportation network has to be open and nondiscriminatory.

5.35 *Openness* ensures that the transportation network is open to parties other than the transporter. *Nondiscrimination* is an obligation on part of the transporter not to favor any party for the usage of transportation network.

5.36 There are two ways of arranging access to the transportation network: negotiated third-party access (NTPA) and regulated third-party access (RTPA). Figure 5.5 sets out those options graphically.

Figure 5.5. Options for Accessing Transportation Network



Source: World Bank, 2004.

5.37 In case of NTPA, the owner and operator of the transportation network negotiates terms and conditions with a potential shipper(s) and/or supplier(s) to convey gas on its transportation network. If the transporter is a fully unbundled company whose only responsibility is to transport gas on its network, it has an incentive to increase usage of its pipeline by third parties to maximize its revenues. Being a sole transportation company, the transporter does not have any conflict of interest, and that negotiation of access is likely to lead to optimal outcomes.

5.38 The situation is different in the case of gas markets that continue to be vertically integrated (or not fully unbundled) such as the Lebanese gas market (and, in fact, most gas markets in industrial and developing countries around the world). In such market environments, where the gas transporter is also involved in the upstream purchase of gas, gas import, and supply activities, NTPA does not lead to efficient outcomes. The transporter has a conflict of interest in allowing third parties to access its pipeline, as that would allow other parties to compete in the supply of gas to final customers.

5.39 **Unless the Government of Lebanon decides to prohibit gas transportation businesses to engage in any competitive activity (that is, gas import, shipping, and supply), the adoption of RTPA rules is recommended for all existing and new pipeline developments. This will ensure that third parties (that is, gas importers, shippers, and suppliers) can enter the Lebanese market and sell gas to large consumers (achieving wholesale competition) and in the future, when a distribution network may have been developed, to smaller customers (achieving retail competition) at a level playing field.**

A Future Competitive Gas Market Structure

5.40 In the short to medium term, it is likely that the Lebanese gas market will be dominated by a few players. MEW (and/or BOOT) as the main gas importer, the BOOT (and/or Oil Installation Company) as owner and operator of the gas network, and a few anchor customers, including Bedawwi and Zahrani power stations.

5.41 The Government of Lebanon envisages that the demand for gas will increase substantially beyond the initial gas import contract with the Government of Syria. Lebanon will have to identify additional sources of gas supply to meet future demand.

5.42 To meet the need for increased infrastructure and create efficient competition, the government will need to engage the private sector, as planned for in the case of the National Pipeline, to allow for supply of gas from additional sources.

5.43 Creating efficient competition and attracting private capital will require competitive market structures (that is, separation of contractual arrangements, creating RTPA and unbundling competitive

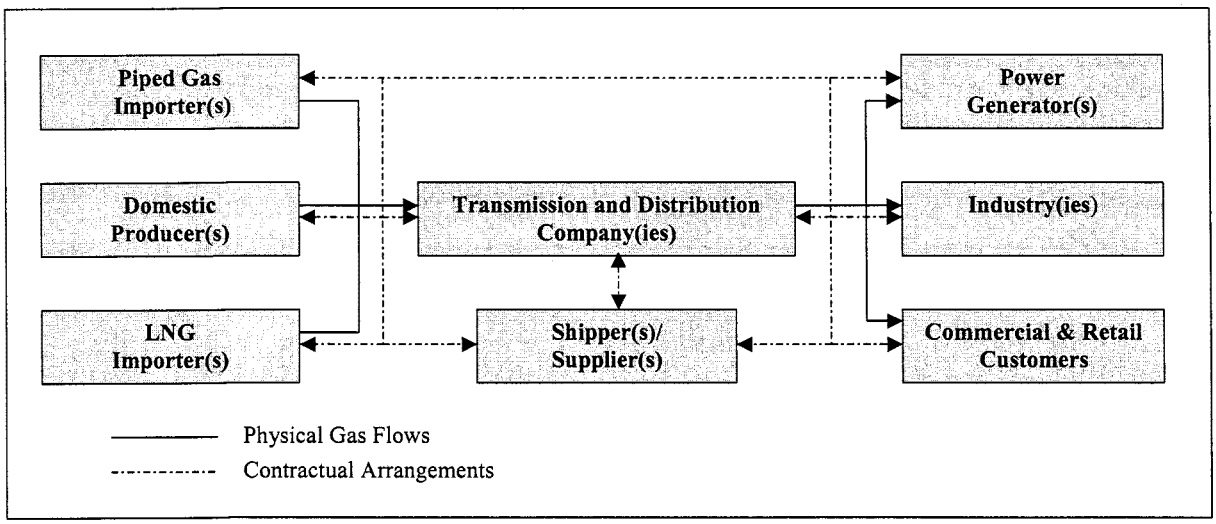
from monopoly activities) and the development of an efficient regulatory framework that reduces regulatory risk and allows investors to recover their investment capital and make a reasonable rate of return.

5.44 It is envisaged that in a future competitive gas market in Lebanon the following elements will exist:

- Multiple importers of natural gas from multiple sources (including Syria, Egypt, Iraq, Lebanon, and potentially LNG);
- Independent gas transportation and possibly distribution business(es) that own, operate, and maintain the gas network;
- Multiple shippers and suppliers that are eligible to supply customers in Lebanon and that have third-party access to the pipeline network; and
- Industrial and possibly domestic consumers that have the freedom to choose their own gas supplier.

5.45 Figure 5.6 presents the structure and the physical gas flows envisaged to enable a future competitive gas market in Lebanon, with multiple sources of gas (for example, import, LNG if prices become more competitive, and domestic production if the seismic surveys prove there are gas reserves), independent transmission, and possibly distribution network business(es) and various types of final consumers. This figure also illustrates that all costumers are eligible to choose their owns suppliers.

Figure 5.6. The Future Gas Market Structure in Lebanon



Note: LNG = liquefied natural gas.
Source: World Bank 2004.

6. Legal and Regulatory Framework for the Gas Sector

THE LEGAL FRAMEWORK

6.1 To attract private capital in the gas sector and establish a market structure that allows efficient competition to develop, a comprehensive legal and regulatory framework will need to be established. This section discusses the importance of establishing primary legislation that sets out the general principles and guidelines that govern the gas sector in Lebanon and discusses key aspects for establishing an efficient regulatory framework. A list of existing legislation that affect the gas sector and a Model Gas Law are attached as Annex 6 and 7 of this report, respectively.

The Importance of Establishing a Natural Gas Law

6.2 It is a widely accepted view that, if gas market reform and regulation are to be effective and command the confidence of all parties, it is imperative that they are founded on a firm legal basis, which requires the development of primary legislation (that is, a gas law for Lebanon).

MODEL GAS LAW

6.3 The Model Gas Law (Annex 7) is the principal recommended instrument for implementing downstream gas regulation. It is based on international experience and practice in downstream gas legislation, and gives effect to the recommendations contained in this study.

6.4 The Model Gas Law uses concepts contained in laws from a number of other nations, including Argentina, Brazil, Canada, Mexico, the United Kingdom, and the United States of America. The laws reflect international best practices in terms, for example, of the structure and functioning of the regulator and the nature and use of the licensing system that is the principal instrument for regulatory implementation. The Model Gas Law is an aid to acquire a better understanding of the recommendations in this study and give effect to the recommendations made here.

6.5 The drafting style of the Model Gas Law conforms to the style used in some of the jurisdictions on which it was based. No attempt was made to follow Lebanese norms for legislative drafting. It is expected that the government will draft a gas law according to appropriate Lebanese style. In that respect, any suggested provisions are shown more as a checklist than as actual drafting suggestions to the government.

6.6 Economic regulation is the focus of the Model Gas Law (as contemplated by section 6.20), not technical regulation (such as safety, environmental matters, and so on).

6.7 The Model Gas Law is designed to separate gas policymaking from gas regulation as contemplated in section 6.10, and is designed to implement the gas market strategy recommended in section 5.15 and required for a competitive gas market, involving the following:

- Unbundling competitive activities from monopoly activities;
- Separating contractual arrangements; and

- Allowing open access to the transportation network.

6.8 The Model Gas Law achieves these objectives in the following methods:

- Unbundling is achieved through financial separation, as described in section 5.20;
- Contractual separation, as contemplated in section 5.26, is achieved by requiring separate transportation contracts and commodity contracts; and
- Open access is achieved through RTPA as described in section 5.34.

6.9 The Model Gas Law contemplates that the policy function of the Minister will be separate from the regulatory functions of the Regulator. The Minister will provide general policy guidance to the Regulator, which is to be taken into account by the Regulator. However, the Ministry does not have the right or power to intervene in any specific issue or matter that may be brought before the Regulator.

6.10 This study contemplates the establishment of a joint gas and electricity regulator, or a multisector regulator. The Model Gas Law is consistent with this recommendation in establishing that the Regulator be one and the same with the regulator established under the Law on Electricity Sector Organization. It is recommended that the Regulator be an agency that is independent and applies principles of equality, openness, accountability, transparency, and nondiscrimination. The Regulator would exercise its functions by means of granting, modifying, and revoking licenses; making directions and decrees; conducting inquiries; issuing orders requiring compliance with applicable law and licenses; assess penalties; and making its own procedural and other rules regarding matters within its jurisdiction.

6.11 The Model Gas Law suggests that decisions of the Regulator are final, except for appeals on questions of law, jurisdiction, or bias on the part of a member of the Regulator who participated in the decision, or of compliance with the rules of procedural fairness.

6.12 The funding of the Regulator is a matter for consideration by the government. The Model Gas Law adopts an approach that is now widely used in other jurisdictions, where all or a portion of the costs of the Regulator are recovered through fees, levies, or charges on regulated enterprises.

6.13 The Model Gas Law adopts a licensing approach to regulation of the gas industry. This is consistent with the practice in a wide range of jurisdictions, where the right to conduct typical industry activities (such as conducting transmission or distribution on a pipeline, or the supply of gas) are authorized by means of a license issued by the Regulator. It is contemplated that the Regulator would create model licenses, for which an applicant would then apply, with variations from the model as appropriate to the circumstances. The Model Gas Law suggests that these model licenses would contain provisions requiring open access to pipelines in accordance with access rules established by the Regulator, and require the Regulator to establish, review, and revise transportation tariffs between pipeline enterprises and users, and supply tariffs where the pipeline enterprise is the gas supplier.

6.14 The Model Gas Law is designed to be suitable for Lebanon's future market as contemplated by the government and this report, which involved multiple supply sources, multiple pipelines, multiple market sectors, and buyers. In the short term, however, there will be only one pipe, one buyer, and one seller, all of them being the government or government-controlled corporations such as EdL. This means that the draft law creates a rather significant regulatory structure and process for the initial situation, certainly greater than what is required for this initial period.

6.15 **It is recommended that the Model Gas Law nevertheless be adopted, because failure to do so will likely be a hurdle to creating the competitive structure with private participation that is contemplated by the government for the near future and recommended by this study.** Private

investors will need to have comfort that there will be a suitable regulatory system before they invest; the draft law allows them to see this. It also reduces the risk that a more developed market structure will not be dominated by the initial monopoly participant, who would naturally seek to restrict competition and protect its vested interests in avoiding competition. Also, the complexity of the draft law in the short term for the single pipeline, single supplier, single shipper, and single buyer situation is not that significant, as the four licenses that would be required under the Model Gas Law could be granted in a single instrument. The regulatory agency recommended by this report would be a joint gas and electricity or multisector regulator, whose gas functions would largely lie dormant before the expected development of a more active gas market (with multiple suppliers, pipelines, and buyers).

6.16 LNG has been included in the Model Gas Law as a potential supply source, but all LNG references are shown in square brackets, reflecting its tentative nature. This identifies how LNG would be included in the Model Gas Law if the government decides to include in the legislation the details required to allow for an LNG supply in Lebanon. As noted elsewhere in this report, it is considered unlikely that LNG prices can be competitive with other gas supply prices in Lebanon in the short to medium term, so the inclusion of LNG is not necessarily required at this time or recommended.

6.17 **The Government of Lebanon should adopt legislation similar in function to the Model Gas Law, to allow economic regulation of the downstream gas industry.**

THE REGULATORY FRAMEWORK

The Concept of Regulation

6.18 The development of a competitive gas market structure and private participation in the Lebanese gas market has to be accompanied by establishing an efficient regulatory framework, often referred to as economic regulation.[49]

6.19 Economic regulation is more than just setting technical and safety standards and guidelines for the gas industry. Economic regulation refers to ongoing price regulation of monopoly activities (that is, transmission and distribution) and potentially competitive activities (that is, retail and supply), until effective competition has been established.

6.20 To establish a comprehensive framework for economic regulation in Lebanon the following has to be addressed, namely:

- *How* to separate policy from regulation,
- *Who* shall regulate, and
- *How* shall regulation be conducted.

SEPARATION OF GAS POLICY AND REGULATION

6.21 A key requirement for establishing an efficient regulatory framework in Lebanon is to clearly separate powers in the gas industry between agencies and institutions dealing with matters of policy and regulation.

[49]The term economic regulation is widely used in the context of regulation of monopoly network industries (i.e., telecommunication, natural gas, electricity, and water).

6.22 The gas industry is a capital-intensive industry, where companies have to make long-term investment in the network, and tariffs have to ensure that companies can recover those investments and make a reasonable rate of return. Hence, economic regulation should be carried out independently to ensure that political considerations do not influence the operation and financial viability of the industry in the long term.

6.23 In addition, in many emerging markets vertically integrated state-owned entities often carry out regulatory functions. Removal of all policymaking and regulatory functions from industry participants is crucial in terms of avoiding potential conflicts of interests and allowing a level playing field for private investment and the introduction of competition.

6.24 Table 6.1 below summarizes separate functions and responsibilities of the various entities that are involved in the downstream gas sector in Lebanon.

Table 6.1. Key Functions of Gas Market Participants

Government	Regulator	Industry	Consumer
-establish gas market policies -formulate primary gas legislation -set guidelines for economic regulation -develop new policy issues	-regulate independent and impartial -design and enforce tariff mechanism -issue, monitor, and enforces license conditions -develop technical and safety regulations	-provide goods and services -earn reasonable rate of return -have rights and obligations as specified under legislation and regulations	-receive good quality service at competitive prices -have rights and obligations as specified under legislation and regulations

Source: World Bank, 2004

6.25 **The roles and responsibilities of the Lebanese Government and the proposed regulator for the downstream gas sector should be clearly defined in primary legislation (that is, the gas law) that allows for the development of an efficient regulatory regime for the gas sector.**

WHO SHALL REGULATE THE GAS INDUSTRY?

6.26 There are a set of criteria that can be used to identify the best option for setting up a regulator in Lebanon, including the following:

- Independence from political interference,
- High transparency of regulatory processes,
- Minimum regulatory risk for gas companies,
- Attractiveness to private investors, and
- Feasibility and practicality of establishing institutions.

6.27 There are basically three institutional options for setting up a gas regulator in Lebanon, including the following:

- As part of an existing government institution,
- As a newly created institution, or
- As a joint energy (or multisector) regulator.

6.28 Establishing the gas regulator as part of an *existing government institution* (such as the MEW) does not provide the necessary independence of regulation from policy and increases regulatory risk. Most developed gas markets around the world have avoided this type of arrangement. Although the creation of a new independent regulatory institution is a widely adopted practice around the world, it might not be practical and economical in the Lebanese context.[50] This is mainly because of the relative small size of the gas market, the costs for setting up and running an independent gas regulator, the convergence of gas and electricity markets in Lebanon, and the creation of National Electricity Regulatory Authority.[51]

6.29 **Considering the convergence of the gas and electricity market in Lebanon and the relatively small size of the gas sector, a joint gas and electricity (or a multisector) regulator should be established.**

HOW SHALL REGULATION BE CONDUCTED?

6.30 The question of how regulation is conducted relates to a variety of aspects of regulation, ranging from the nature and types of the detailed rules applied to regulated businesses to the regulatory processes and procedures followed by the regulatory agency.

6.31 Economic regulation consists of the following key responsibilities, namely:

- Granting and enforcing licenses/concessions;
- Tariff regulation;
- Network planning and investment approval;
- Quality of supply regulation;
- Technical regulation; and
- Handling customer complaints.

6.32 The regulatory authority must exert control over regulated gas companies. Licenses are common instruments to act as a regulatory contract, setting out the regulatory rules and the relationship between the regulator and the regulated company. At the same time, a license gives the regulated company assurance that the rules of the regulatory game cannot easily be changed.

6.33 A key function of any regulatory regime is tariff control and supervision. The regulatory authority will have to develop detailed tariff review policies and procedures.

6.34 The regulatory authority must have a role in the planning and investment approval process for greenfield gas pipeline developments. Active involvement and approval procedures and regulations will provide the regulator with some control over capital investment that form the major cost component of a gas network business. That supervisory and approval role is crucial as regulated companies should be allowed to recover their prudently incurred investment costs through regulated transportation tariffs. It

[50] Joint gas and electricity regulators are common in energy markets around the world. One major reason for establishing joint regulators is that gas and electricity markets tend to converge as natural gas becomes a major fuel source for power generation. The convergence of gas and electricity markets was the main reason for the merger of Offer (electricity) and Ofgas (gas) in the United Kingdom in 1999 to form Ofgem (The Office for Gas and Electricity Markets). Other joint gas and electricity regulators include FERC (Federal Energy Regulatory Commission) in the United States and the EMA (Energy Market Authority) in Singapore that has been recently established.

[51] Refer to Article 7 and Article 8 of Law No. 462 on the creation and management of the Authority.

will be the responsibility of the regulator to develop a process that determines whether new capital investments are prudently incurred.

6.35 In regulating tariffs, the regulator must not only investigate the costs of providing a regulated service but also the quality of the services provided. Service quality includes gas quality (for example, calorific value), gas pressure, number of supply interruptions, and others.

6.36 The regulator should have a key role in the technical regulation of the Lebanese gas sector. Technical regulation responsibilities include specifying and monitoring the technical principles of operating the gas network to ensure environmental, health, and safety standards. Technical principles should be set out in relevant regulations and industry codes governing the operation of the gas transportation network.

6.37 One of the main functions of economic regulation is to protect the interest of gas consumers. An important part of customer protection is overseeing the handling of customer complaints. The regulator will want to ensure that complaints are handled effectively and resolved quickly, because it as an important aspect of service quality.

6.38 **Within the role and responsibility of the designated regulatory agency, it should develop relevant regulations for the gas market in Lebanon in consultation with relevant stakeholders.**

7. Benefits of Introducing Natural Gas

7.1 Lebanon can expect significant benefits from the introduction of natural gas. Key benefits include the cost reduction of power production, which will have positive effects on the financial position of EdL and the country's trade and current account balances and environmental benefits that are associated with switching from oil to the relatively cleaner fuel, natural gas.

BENEFITS TO THE POWER SECTOR

7.2 In 2002, power generation accounted for 54 percent of energy consumption in Lebanon with 43 percent of energy used by EdL, the national electricity utility, and an additional 11 percent by private generators. The two main energy sources for power generation are gas oil (that is, diesel) and fuel oil. In 2002, 75 percent of fuel oil imported in Lebanon was used by EdL. Private generators[52] mostly run on gas oil. EdL and private power generators consume about 87 percent of imported gas and fuel oil, respectively. Table 7.1 below provides an overview of fuel consumption volumes of EdL's generators in 2002.

Table 7.1. Fuel Consumption and Type of Fuel Used by EdL Power Plants, 2002

Plant	Fuel Consumption (tons)	Type of Fuel
Bedawwi	332,133	gas oil
Zahrani	412,631	gas oil
Zouk	780,203	fuel oil
Jieh	525,972	fuel oil

Source: MEW, 2003

7.3 The conversion of power stations to natural gas from fuel and gas oil would decrease oil product consumption in near future.[53] The substitution of oil products imports by natural gas is likely to have positive impacts on the trade and current account balance and the financial viability of the electricity sector and will facilitate the restructuring of EdL. The MEW has identified three major categories for cost savings in the Lebanese generation market when switching to natural gas:

- Fuel costs;
- Operating and maintenance costs; and
- Environmental costs (negative externalities and carbon credits).[54]

7.4 Fuel costs are the main cost component of power generation and switching to natural gas will substantially reduce those costs with positive effects on generation costs and final electricity tariffs. MEW estimated that, based on different crude oil prices, annual fuel cost savings for power generators are between US$90 to 140 million.

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[52] Self-generation is provided by diesel generators supplying a range of commercial, industrial, and agricultural as well as residential customers. Lebanon has a high ownership rate for small generation sets and, although there are no accurate data available, some estimate self-generation to be around 15 percent of the total supply. The relative large percentage of self-generation is caused by lack of electricity infrastructure and frequent power brown- and blackouts. The government expects that the share of private generation will decrease as EdL becomes more efficient and as network is rehabilitated and extended.

[53] The transportation sector primarily relies on import of diesel and gasoline, which are difficult to substitute.

[54] MEW, Lebanese Republic. October 2003. "Role of Natural Gas in EdL Power Plants."

Table 7.2. Estimated Annual Savings Using Natural Gas for Power Generation

Brent Oil Price (US$/barrel)	Annual Savings (US$ million)
20	91.4
22	96.7
24	100.0
26	106.7
28	111.5
30	139.5

steam

7.5 MEW also estimated that switching to natural gas would reduce operating and maintenance costs of power plants by about US$9 million per annum. Most savings are likely to be achieved by the two major generators in Bedawwi and Zahrani through savings in spare parts, and fuel and gas oil handling costs including operation of storage, terminals and trucks.

Table 7.3. Operation and Maintenance Saving Per Power Plant, 1998

Power Plant	Generation Capacity (MW)	US$/Year	US$/Year/Unit
Zouk 1-3	3 x 145	125,000	375,000
Zouk 4	1 x 170	125,000	125,000
Jieh	2 x 60	95,000	190,000
Jieh	3 x 65	95,000	285,000
Bedawwi CC		4,155,000	4,155,000
Zahrani CC		4,155,000	4,155,000
TOTAL			**9,285,000**

7.6 The access to natural gas also allows for the construction of new CCGT plants, and the MEW estimated that major capital investment savings can be achieved by switching to gas-fired power plants and expected an increased plant lifetime of five to seven years. Another major saving potential is the fuel efficiency of CCGT plants. These plants have a relatively higher conversion efficiency than conventional TPPs producing additional electricity from the same volume of fuel.

7.7 Estimates undertaken by the World Bank support the significant savings potential that gas could bring. The calculations are for the Bedawwi and Zahrani CCGTs, which are ready to receive gas at no conversion cost. Pipeline costs to transport gas to Zahrani have not been taken into account.

7.8 Based on 2,500 operating hours per year, gas oil consumption is 550,000 tons/year[55] at each plant. At $320/ton[56] annual gas oil costs would be US$176 million. Under this scenario, the cost of Syrian gas would be US$66 million per year and per plant, assuming a gas price of $3.40/mmbtu (or about $120/ton equivalent). The net savings would be **US$110 million**. If plant reliability is increased to match industry standards of 3,500 GWh/year, the annual savings become **$150 million** per plant.

[55] National Electricity Regulatory Authority Tariff Study 2003.
[56] Price as of April 2004.

7.9 Similarly, for gas oil at US$190/ton (roughly US$20/barrel oil) the savings are **US$58 million** at 2,500 GWh/year and **US$80 million** at 3,500 GWh/year. For gas oil at US$25/barrel, the annual savings would be about **US$85 million** at 2,500 GWh/yr and **US$115 million** at 3,500 GWh/year.

BENEFITS TO THE ENVIRONMENT

7.10 The introduction of natural gas to Lebanon is expected to have significant positive effects on the environment, notably on air quality. Thermal power generators are a major source of green house gas (GHG) emissions, and using natural gas will substantially lower pollutant emissions with all its positive effects on the environment and health. Switching to natural gas for power generation also has positive effects on water. Power plants, as a major user of petroleum products, have to unload and store oil products routinely. Frequent spills and accidental discharges may occur during unloading. Most plants and storage facilities in Lebanon are on the coast and oil is delivered by tankers that may cause pollution to seawater.

7.11 At the same time, the construction of greenfield gas pipelines often raise environmental and social issues that have to be carefully addressed. The Lebanese government will have to carry out a comprehensive environmental and social assessment to ensure that any negative impacts of a greenfield gas pipeline are properly addressed and that the overall benefits of the introduction of natural gas to Lebanon outweigh its costs.

7.12 This section presents the potential benefits to Lebanon in terms of avoided damage costs (the negative externalities) from the introduction of natural gas and will provide an overview of the environmental and social aspects that have to be considered in greenfield pipeline projects.

Air Quality Impacts due to Switch from Oil to Natural Gas

7.13 Lebanon lacks a comprehensive air quality and emissions monitoring program, including equipment, which limits the ability to undertake detailed quantitative assessments to analyze the potential impact from introducing natural gas on emission levels.

7.14 Some air quality monitoring and measuring has been undertaken in places such as Beirut and Chekka and along highways. That information and data, in combination with visual observations, health statistics, and some studies carried out by the Ministry of Environment, indicate that there is severe pollution in the large cities (in particular Beirut and Tripoli) and close to highly polluting industrial facilities (for example, cement factories) and TPPs (for example, Zouk and Jieh). This information, along with relevant statistics from other countries, has been used to develop some estimates of potentially avoided damage costs because of the introduction of natural gas.

7.15 To estimate the potential benefits from reduced pollution from Sulfur Oxides (SOx), Nitrogen Oxides (NOx), PM10 (particulate matter less than 10 microns), and Carbon Dioxide (CO_2), the consultant (CEPCO) has quantified environmental externalities for Lebanon based on data from various sources, most notably from ExternE[57] and Pace University.[58] ExternE has developed an accounting framework for 12 fuels, including natural gas. For each fuel, the accounting framework includes the application of the methodology to that specific fuel cycle, detailed quantification of the impacts, and their evaluation in

[57] The ExternE project is the first comprehensive attempt to use a consistent bottom-up methodology to evaluate the external costs associated with a range of different fuel cycles. The European Commission launched the project in collaboration with the U.S. Department of Energy in 1991.

[58] CEPCO. November 2003. "Report Task 7: Environment."

monetary terms. Greece, one of the countries included in the ExternE work, has been used as a proxy for Lebanon in the analysis because of similarities in size, climate, and stage of economic development. The Pace University study is the most comprehensive assessment of environmental externalities in the United States, and while relatively old (issued in 1990), it remains a good source of information. While there are many differences between Lebanon and the United States, the Pace University data was as an additional indicator for selecting a range of externality values, which have been used to develop a first estimate of the environmental damage costs in Lebanon. These ranges selected are shown in Table 7.4 below:

Table 7.4. Estimation of Environmental Externalities for Lebanon (US$/ton)

	Low	High
SO_x	2,000	5,000
NOx	1,400	3,000
PM10	2,000	5,000
CO_2	5	20

Note: SO_x = Sulfur Oxides; NOx = Nitrogen Oxides; PM10 = particulate matter less than 10 microns; CO_2 = Carbon Dioxide.
Source: CEPCO 2004.

7.16 To estimate the potential benefits from the introduction of natural gas, two scenarios were compared:

- First, a *baseline scenario* that assumes that no natural gas will be introduced in Lebanon and power plants will continue to burn fuel and gas oil;
- Second, a *maximum natural gas scenario* that assumes that Bedawwi, Zahrani, and Zouk will operate on natural gas.

7.17 Detailed assumptions are outlined in Table 7.5 below

Table 7.5. Assumptions for Baseline and Maximum Gas Scenario

	No Gas Scenario	Maximum Gas Scenario
Electric Power Demand	Base Case (Table 1.1)	Base Case (Table 1.1)
New Gas Pipeline Construction	No gas pipelines are constructed	Homs—Bedawwi in 2005 Bedawwi—Zahrani in 2006
New Plant Commission	478MW CCGT, distillate oil, in 2008 204MW CCGT, distillate oil, in 2018	478MW CCGT, Egypt gas, in 2008 204MW CCGT, Egypt gas, in 2015
Existing Power Plants	Zouk, Jieh: Continue to be oil fired Bedawwi, Zahrani: Continue to be distillate fired	Bedawwi: Gas conversion in 2005 Zahrani: Gas conversion in 2006 Zouk: Gas conversion in 2008 Jieh: Continue oil fired

Note: MW = megawatt; CCGT = Combined Cycle Gas Turbine.
Source: CECPO, 2003.

7.18 Detailed calculations on the two scenarios are presented in Annex 8 and show that the introduction of natural gas into the power sector of Lebanon could reduce environmental and health damages between U$743 million to US$1.8 billion for the period 2005–20. It is estimated that the majority of the benefits are due to reduction in sulfur emissions, followed by reductions in NOx emissions.

Potential Impact due to Natural Gas Pipelines

7.19 Gas pipelines could have a significant impact on the environment during construction, start-up/commissioning, and operation depending on the environmental sensitivity of the areas through which they run, their design (aboveground/underground, pipeline size and pressure, location of pressure stations, and so on), and operating procedures. Environmental issues may arise because of the following factors:

- Resettlement
- Loss of land for agricultural and other use
- Encroachment into sensitive ecological areas and interference with navigation/fisheries(for submarine pipelines)
- Damage of historic and cultural monuments
- Endangerment of species and blockage of wildlife passageways
- Gas leaks
- Explosion and fire hazards
- Interference with drainage patterns
- Erosion hazard due to inadequate provision for resurfacing of exposed areas

7.20 Proper Environmental Impact Assessments (EIAs) will need to be undertaken in the context of the proposed natural gas pipeline projects, but a preliminary review of the impact of the two most likely pipeline developments—the National Pipeline project from Bedawwi to Zahrani and Lebanon's participation in the Arab Gas Pipeline—suggests that (a) desertification caused by deforestation, which is usually a significant issue related to the construction of pipelines, needs to be given due consideration and crossing natural reserves should be avoided; and (b) the conservation of historic and cultural monuments will be of key importance in Lebanon where there are several famous historic heritages: Anjar, Byblos, Ba'albeck, Tyre, and Qadisha Vally and Horsh Arzel-Rab.

7.21 **Considering the potential fuel and operating and maintenance cost savings, the Government of Lebanon should promote the introduction of natural gas into the Lebanese power sector. This will encourage interfuel competition with all its positive effects on improving efficiency, costs, and final tariffs. Detailed EIAs should be carried out to assess the environmental costs and benefits of a new greenfield gas pipeline development.**

Annexes

Annex 1: Terms of Reference (TOR)

Objective of the Study: Building on the earlier work done in the energy sector strategy study (Energy Strategy into the Next Millennium 1999), the government has requested the World Bank's assistance in formulating a comprehensive long-term strategy for the introduction and use of natural gas, and the efficient development of the petroleum sector in Lebanon. The strategy will provide a basis by which the government would seek private sector as well as Bank assistance in the development of the hydrocarbons (oil and gas) sector in Lebanon over the medium to long term.

Scope of Services: The scope of services includes the following:

Task 1: Potential Future Gas Market and Demand Forecast

- Review and analyze the existing energy supply and demand situation, including sources of oil supply, and the last five years of oil consumption trends by fuel type and consumer categories, including electricity generation. Prepare an energy balance for Lebanon showing supply and consumption for the past five years.

- Analyze electricity consumption trends in the past five years by consumer category. Analyze supply constraints, and provide annual estimates of unserved energy and power demand. Prepare forecasts of electricity demand, under unconstrained conditions, by consumer category, and for maximum demand up to year 2020.

- Based on the electricity demand forecasts, prepare a least-cost power generation expansion program to meet the projected demand up to year 2020.

- Analyze the potential for substitution of gas for oil for power generation in the existing power plants, including the timing.

- Analyze the potential for gas use in sectors outside the electric power sector, including households, industry, and commercial applications, and timing of use in each sector.

- Based on the gas requirements for power generation, and in non-power sectors, prepare gas demand by sector and global aggregate for each year until the year 2020.

Task 2: Analysis of Supply Options and Recommendations

- Review the potential for the development of a regional gas market, and the potential benefits for Lebanon to integrate in the regional market.

- Review and analyze the regional sources of gas, and ongoing and proposed future gas transmission pipeline developments.

- Identify potential sources of natural gas supply to Lebanon, and analyze feasible options of supply and quantities, including preliminary cost estimates of pipeline routings for bulk gas delivery to power plants and large consumers, and timing of deliveries. On the basis of analyses, provide recommendations on preferred options.

- Identify potential sources of supply of liquefied natural gas (LNG) to Lebanon, and analyze feasible options, associated costs of delivery, including port infrastructure, preliminary estimates of pipeline costs for bulk delivery to power plants and large consumers, and timing of deliveries. Based on the analyses, provide recommendations on feasible options.

- Identify and analyze supply security issues associated with natural gas and LNG supplies to Lebanon, and provide recommendations, including the structuring of ownership and financing of international/interregional transmission pipeline developments to mitigate risk.

- Based on the above, provide recommendations on the choice between gas supply option, and LNG supply option.

Task 3: Natural Gas and Petroleum Products Pricing, and Macrofiscal Implications

- Analyze potential macroeconomic/fiscal impacts of gas supply to Lebanon, based on gas pricing in existing transboundary gas supply arrangements in the region—for example, gas supply from Egypt to Jordan—adjusted for relevant key factors, gas supply from Syria to Lebanon, and feasible alternative pricing arrangements for gas supply to Lebanon.

- Review and analyze the existing structure of petroleum product prices, indicating the makeup by components—product cost, transportation and handling costs, taxes, and margins—and assess/comment on adequacy of level taxes and wholesale/retail margins relative to internationally accepted practice for each product.

- As necessary, provide recommendations on tax adjustments, wholesale/retail margins, and price levels. The economic rationale for such adjustments should be provided.

- Review government policy on setting petroleum product prices, especially regarding periodic adjustments to at least maintain economic cost levels, and recommend changes as necessary to meet objectives of efficient competitive market;

- Review the current contribution of taxes on petroleum products to government revenues, and the main product contributors. Assess the revenue implications of the recommended taxation of petroleum products on the government budget.

Task 4: Gas Market Structure and Private Sector Involvement

- Analyze various forms of gas industry structures, merchant functions, issues of exclusivity, and single-buyer, open-access linkages with the various forms of private sector participation, while taking gas supply sources into account. Provide recommendations on preferred options for industry/market structure, in the context of Lebanon, as well as preferred options for private sector involvement.

Task 5: Legal and Regulatory Framework

- Review the existing legal and regulatory framework for oil to assess conformity with government policy objectives of creating a liberalized competitive petroleum products market, with active private sector participation. Currently, there is no legal framework for gas. Based on the review of the existing law for petroleum, provide assistance to government and the MEW to prepare a draft law for oil and gas in line with government policy objectives, and in conformity with international best practices for submission to the Parliament. The draft law should provide the

basis for establishing product standards; monitoring product quality; enforcement, including the basis of establishing penalties for infringement; and health and safety.

Task 6: Preliminary Feasibility Study of Tripoli and Zahrani Refineries

- Provide a review of the existing refineries in the region, and the relative use of available refining capacity. Provide a comprehensive table of types of refineries, installed capacity, capacity utilization, country of location, and year of commission.

- Undertake a preliminary technical audit of the state of the Zahrani and Tripoli refineries, and associated facilities. Based on the technical audits, undertake a preliminary technical and economic feasibility study of the merits of rehabilitation and the modernization of refineries. The analysis should also take into account strategic locations of the refineries, the projected growth of the local oil products market and its evolution with the introduction of natural gas/LNG, and export markets within the Mediterranean region.

- Based on the above, provide recommendations on actions to be taken (closure/ rehabilitation/modernization and expansion) regarding each refinery.

Task 7: Environment

- Provide an assessment of the environmental and potential health impacts of use of oil in power generation from existing plants. This should take into account the location of the existing plants, estimates of emissions levels by type, disposal and leakages of oil, and impacts on ground water, and so on.

- Assess environmental impacts of gas use and comparative analysis of impacts with oil use in power plants.

- Identify potential impacts of possible pipeline routings. This does not imply detailed EIAs but enumerates the potential impact issues of the routing associated with the preferred option.

Annex 2: Energy Balance

Table A-1. Lebanon Tabular Energy Balance, 1998

	Gas Oil	Fuel Oil	Gasoline Leaded (98)	Gasoline Unleaded (90)	Jet Kerosene	LPG	Hydro	Electricity Import (Syria)	Other Fuels	Total (GJ)	
Sources of Primary Energy (GJ)											
Imports (Tons)	1,424,618	1,588,380	1,189,254	222,502	106,881	138,000	-	-	-		
GJ/ton	43	40	45	45	45	47	-	-	20		
Imported Electricity (kWh)	-	-	-	-	-	-	-	654,000,000	-		
Indigenous Production: Electricity (kWh)	-	-	-	-	-	-	750,608,280	-	-		
Other energy (Tons)	-	-	-	-	-	-	-	-	100,000		
Energy Supply GJ equivalent	61,733,513	63,842,202	53,277,105	9,914,057	4,765,762	6,528,896	5,272,565	2,354,400	2,000,000	209,688,500	
Fuel proportion in total	29%	30%	25%	5%	2%	3%	3%	1%	1%	100%	
Uses of Primary Energy (GJ)											
Residential	2,943,414	-	-	-	-	4,896,672	-	-	670,000	8,510,086	4.1%
Residential Space Heating	1,142,337	-	-	-	-	-	-	-	-	1,142,337	0.5%
Commercial	1,976,920	-	-	-	-	652,890	-	-	450,000	3,079,810	1.5%
Commercial Space Heating	767,241	-	-	-	-	-	-	-	-	767,241	0.4%
Industrial	3,250,935	5,945,917	-	-	-	979,334	-	-	740,000	10,916,186	5.2%
Agricultural	351,452	-	-	-	-	-	-	-	80,000	431,452	0.2%
Transport	1,909,579	-	53,277,105	9,914,057	4,765,762	-	-	-	-	69,866,502	33.3%
Other	263,589	-	-	-	-	-	-	-	60,000	323,589	0.2%
EdL (GJ)	6,508,620	15,434,640	-	-	-	-	2,296,861	2,001,240	-	26,241,361	12.5%
Petroleum Refineries	-	-	-	-	-	-	-	-	-	-	0.0%
EdL Conversion Losses	15,884,742	39,709,151	-	-	-	-	2,570,376	-	-	58,164,269	27.7%
Private Gen Conversion Losses	25,586,102	28,734	-	-	-	-	-	-	-	25,614,836	12.2%
Transmission Losses	1,148,580	2,723,760	-	-	-	-	405,328	353,160	-	4,630,828	2.2%
Intermediate Energy Use: Primary Energy in Electricity											
Energy in Electricity Production (GJ)											
Residential	11,514,759	-	-	-	-	-	-	-	-	11,514,759	
Commercial	7,733,793	-	-	-	-	-	-	-	-	7,733,793	
Industrial	12,717,793	41,874	-	-	-	-	-	-	-	12,759,667	
Agricultural	1,374,897	-	-	-	-	-	-	-	-	1,374,897	
Other	1,031,172	-	-	-	-	-	-	-	-	1,031,172	
EdL	23,541,942	57,867,551	-	-	-	-	5,272,565	2,354,400	-	89,036,459	
Total energy use in electricity (GJ)	57,914,356	57,909,426	-	-	-	-	5,272,565	2,354,400	-	123,450,747	
Electricity Produced (GJ equivalent)											
Residential	2,943,414	-	-	-	-	-	-	-	-	2,943,414	
Commercial	1,976,920	-	-	-	-	-	-	-	-	1,976,920	
Industrial	3,250,935	13,140	-	-	-	-	-	-	-	3,264,075	
Agricultural	351,452	-	-	-	-	-	-	-	-	351,452	
Other	263,589	-	-	-	-	-	-	-	-	263,589	
EdL	7,657,200	18,158,400	-	-	-	-	2,702,190	2,354,400	-	30,872,190	
Total Electricity Produced (GJ)	16,443,512	18,171,540	-	-	-	-	2,702,190	2,354,400	-	39,671,642	
EdL conversion losses	15,884,742	39,709,151	-	-	-	-	2,570,376	-	-	58,164,269	
Private gen conversion losses	25,586,102	28,734	-	-	-	-	-	-	-	25,614,836	
Total Conversion Losses	41,470,844	39,737,886	-	-	-	-	2,570,376	-	-	83,779,105	

Note: LPG = liquefied petroleum gas; GJ = Gigajoul; kWh = kilowatt hour; EdL = Electricité du Liban.
Source: CEPCO, 2004.

Table A-2. Lebanon Tabular Energy Balance, 1999

	Gas Oil	Fuel Oil	Gasoline Leaded (98)	Gasoline Unleaded (90)	Jet Kerosene	LPG	Hydro	Electricity Import (Syria)	Other Fuels	Total (GJ)	
Sources of Primary Energy (GJ)											
Imports (Tons)	1,748,086	1,525,078	1,084,870	259,226	126,166	135,269	-	-	-		
GJ/ton	43	40	45	45	45	47	-	-	20		
Imported Electricity (kWh)	-	-	-	-	-	-	-	846,000,000	-		
Indigenous Production: Electricity (kWh)	-	-	-	-	-	-	309,000,000	-	-		
Other energy (Tons)	-	-	-	-	-	-	-	-	100,000		
Energy Supply GJ equivalent	75,750,475	61,297,887	48,600,831	11,550,375	5,625,669	6,399,690	2,170,537	3,045,600	2,000,000	216,441,063	
Fuel proportion in total	35%	28%	22%	5%	3%	3%	1%	1%	1%	100%	
Uses of Primary Energy (GJ)											
Residential	2,895,413	-	-	-	-	4,799,768	-	-	670,000	8,365,181	3.9%
Residential Space Heating	1,123,708	-	-	-	-	-	-	-	-	1,123,708	0.5%
Commercial	1,944,680	-	-	-	-	639,969	-	-	450,000	3,034,649	1.4%
Commercial Space Heating	754,729	-	-	-	-	-	-	-	-	754,729	0.3%
Industrial	3,197,919	12,345,129	-	-	-	959,954	-	-	740,000	17,243,001	8.0%
Agricultural	345,721	-	-	-	-	-	-	-	80,000	425,721	0.2%
Transport	1,878,437	-	48,600,831	11,550,375	5,625,669	-	-	-	-	67,655,311	31.3%
Other	259,291	-	-	-	-	-	-	-	60,000	319,291	0.1%
EdL (GJ)	8,736,300	14,121,900	-	-	-	-	945,540	2,588,760	-	26,392,500	12.2%
Petroleum Refineries	-	-	-	-	-	-	-	-	-	-	0.0%
EdL Conversion Losses	27,903,734	32,310,024	-	-	-	-	1,058,137	-	-	61,271,895	28.3%
Private Gen Conversion Losses	25,168,842	28,734	-	-	-	-	-	-	-	25,197,577	11.6%
Transmission Losses	1,541,700	2,492,100	-	-	-	-	166,860	456,840	-	4,657,500	2.2%

Intermediate Energy Use: Primary Energy in Electricity

Energy in Electricity Production (GJ)										
Residential	11,326,975	-	-	-	-	-	-	-	-	11,326,975
Commercial	7,607,670	-	-	-	-	-	-	-	-	7,607,670
Industrial	12,510,391	41,874	-	-	-	-	-	-	-	12,552,265
Agricultural	1,352,475	-	-	-	-	-	-	-	-	1,352,475
Other	1,014,356	-	-	-	-	-	-	-	-	1,014,356
EdL	38,181,734	48,924,024	-	-	-	-	2,170,537	3,045,600	-	92,321,895
Total energy use in electricity (GJ)	71,993,601	48,965,898	-	-	-	-	2,170,537	3,045,600	-	126,175,636
Electricity Produced (GJ equivalent)										
Residential	2,895,413	-	-	-	-	-	-	-	-	2,895,413
Commercial	1,944,680	-	-	-	-	-	-	-	-	1,944,680
Industrial	3,197,919	13,140	-	-	-	-	-	-	-	3,211,059
Agricultural	345,721	-	-	-	-	-	-	-	-	345,721
Other	259,291	-	-	-	-	-	-	-	-	259,291
EdL	10,278,000	16,614,000	-	-	-	-	1,112,400	3,045,600	-	31,050,000
Total Electricity Produced (GJ)	18,921,024	16,627,140	-	-	-	-	1,112,400	3,045,600	-	39,706,164
EdL conversion losses	27,903,734	32,310,024	-	-	-	-	1,058,137	-	-	61,271,895
Private gen conversion losses	25,168,842	28,734	-	-	-	-	-	-	-	25,197,577
Total Conversion Losses	53,072,577	32,338,758	-	-	-	-	1,058,137	-	-	86,469,472

Note: LPG = liquefied petroleum gas; GJ = Gigajoul; kWh = kilowatt hour; EdL = Electricité du Liban.
Source: CEPCO, 2004.

Table A-3. Lebanon Tabular Energy Balance, 2000

	Gas Oil	Fuel Oil	Gasoline Leaded (98)	Gasoline Unleaded (90)	Jet Kerosene	LPG	Hydro	Electricity Import (Syria)	Other Fuels	Total (GJ)	
Sources of Primary Energy (GJ)											
Imports (Tons)	1,315,645	1,507,903	965,743	298,014	124,511	165,120	-	-	-		
GJ/ton	43	40	45	45	45	47	-	-	20		
Imported Electricity (kWh)	-	-	-	-	-	-	-	1,417,960,671	-		
Indigenous Production: Electricity (kWh)	-	-	-	-	-	-	433,705,860	-	-		
Other energy (Tons)	-	-	-	-	-	-	-	-	100,000		
Energy Supply GJ equivalent	57,011,345	60,607,567	43,264,089	13,278,658	5,551,873	7,811,966	3,046,519	5,104,658	2,000,000	197,676,676	
Fuel proportion in total	29%	31%	22%	7%	3%	4%	2%	3%	1%	100%	
Uses of Primary Energy (GJ)											
Residential	2,614,445	-	-	-	-	5,858,974	-	-	670,000	9,143,419	4.6%
Residential Space Heating	1,014,664	-	-	-	-	-	-	-	-	1,014,664	0.5%
Commercial	1,755,970	-	-	-	-	781,197	-	-	450,000	2,987,167	1.5%
Commercial Space Heating	681,491	-	-	-	-	-	-	-	-	681,491	0.3%
Industrial	2,887,596	8,554,179	-	-	-	1,171,795	-	-	740,000	13,353,570	6.8%
Agricultural	312,173	-	-	-	-	-	-	-	80,000	392,173	0.2%
Transport	1,696,155	-	43,264,089	13,278,658	5,551,873	-	-	-	-	63,790,775	32.3%
Other	234,129	-	-	-	-	-	-	-	60,000	294,129	0.1%
EdL (GJ)	7,090,663	15,286,873	-	-	-	-	1,327,140	4,338,960	-	28,043,635	14.2%
Petroleum Refineries	-	-	-	-	-	-	-	-	-	-	0.0%
EdL Conversion Losses	14,746,286	34,040,098	-	-	-	-	1,485,178	-	-	50,271,562	25.4%
Private Gen Conversion Losses	22,726,480	28,734	-	-	-	-	-	-	-	22,755,214	11.5%
Transmission Losses	1,251,293	2,697,683	-	-	-	-	234,201	765,699	-	4,948,877	2.5%

Intermediate Energy Use: Primary Energy in Electricity										
Energy in Electricity Production (GJ)										
Residential	10,227,816	-	-	-	-	-	-	-	-	10,227,816
Commercial	6,869,428	-	-	-	-	-	-	-	-	6,869,428
Industrial	11,296,393	41,874	-	-	-	-	-	-	-	11,338,268
Agricultural	1,221,232	-	-	-	-	-	-	-	-	1,221,232
Other	915,924	-	-	-	-	-	-	-	-	915,924
EdL	23,088,242	52,024,654	-	-	-	-	3,046,519	5,104,658	-	83,264,073
Total energy use in electricity (GJ)	53,619,034	52,066,528	-	-	-	-	3,046,519	5,104,658	-	113,836,740
Electricity Produced (GJ equivalent)										
Residential	2,614,445	-	-	-	-	-	-	-	-	2,614,445
Commercial	1,755,970	-	-	-	-	-	-	-	-	1,755,970
Industrial	2,887,596	13,140	-	-	-	-	-	-	-	2,900,736
Agricultural	312,173	-	-	-	-	-	-	-	-	312,173
Other	234,129	-	-	-	-	-	-	-	-	234,129
EdL	8,341,956	17,984,556	-	-	-	-	1,561,341	5,104,658	-	32,992,512
Total Electricity Produced (GJ)	16,146,269	17,997,696	-	-	-	-	1,561,341	5,104,658	-	40,809,964
EdL conversion losses	14,746,286	34,040,098	-	-	-	-	1,485,178	-	-	50,271,562
Private gen conversion losses	22,726,480	28,734	-	-	-	-	-	-	-	22,755,214
Total Conversion Losses	37,472,766	34,068,832	-	-	-	-	1,485,178	-	-	73,026,776

Note: LPG = liquefied petroleum gas; GJ = Gigajoul; kWh = kilowatt hour; EdL = Electricité du Liban.
Source: CEPCO, 2004.

Table A-4. Lebanon Tabular Energy Balance, 2001

	Gas Oil	Fuel Oil	Gasoline Leaded (98)	Gasoline Unleaded (90)	Jet Kerosene	LPG	Hydro	Electricity Import (Syria)	Other Fuels	Total (GJ)	
Sources of Primary Energy (GJ)											
Imports (Tons)	1,533,283	1,738,849	744,690	434,110	128,196	157,733	-	-	-		
GJ/ton	43	40	45	45	45	47	-	-	20		
Imported Electricity (kWh)	-	-	-	-	-	-	-	1,271,277,880	-		
Indigenous Production: Electricity (kWh)	-	-	-	-	-	-	314,708,086	-	-		
Other energy (Tons)	-	-	-	-	-	-	-	-	100,000		
Energy Supply GJ equivalent	66,442,335	69,890,045	33,361,189	19,342,709	5,716,185	7,462,481	2,210,632	4,576,600	2,000,000	211,002,176	
Fuel proportion in total	31%	33%	16%	9%	3%	4%	1%	2%	1%	100%	
Uses of Primary Energy (GJ)											
Residential	3,206,809	-	-	-	-	5,596,861	-	-	670,000	9,473,670	4.5%
Residential Space Heating	1,244,561	-	-	-	-	-	-	-	-	1,244,561	0.6%
Commercial	2,153,827	-	-	-	-	746,248	-	-	450,000	3,350,075	1.6%
Commercial Space Heating	835,899	-	-	-	-	-	-	-	-	835,899	0.4%
Industrial	3,541,849	15,396,161	-	-	-	1,119,372	-	-	740,000	20,797,382	9.9%
Agricultural	382,903	-	-	-	-	-	-	-	80,000	462,903	0.2%
Transport	2,080,459	-	33,361,189	19,342,709	5,716,185	-	-	-	-	60,500,543	28.7%
Other	287,177	-	-	-	-	-	-	-	60,000	347,177	0.2%
EdL (GJ)	8,509,753	14,708,263	-	-	-	-	963,007	3,890,110	-	28,071,133	13.3%
Petroleum Refineries	-	-	-	-	-	-	-	-	-	-	0.0%
EdL Conversion Losses	14,821,673	37,161,311	-	-	-	-	1,077,683	-	-	53,060,667	25.1%
Private Gen Conversion Losses	27,875,704	28,734	-	-	-	-	-	-	-	27,904,438	13.2%
Transmission Losses	1,501,721	2,595,576	-	-	-	-	169,942	686,490	-	4,953,729	2.3%
Intermediate Energy Use: Primary Energy in Electricity											
Energy in Electricity Production (GJ)											
Residential	12,545,170	-	-	-	-	-	-	-	-	12,545,170	
Commercial	8,425,861	-	-	-	-	-	-	-	-	8,425,861	
Industrial	13,855,860	41,874	-	-	-	-	-	-	-	13,897,734	
Agricultural	1,497,931	-	-	-	-	-	-	-	-	1,497,931	
Other	1,123,448	-	-	-	-	-	-	-	-	1,123,448	
EdL	24,833,147	54,465,150	-	-	-	-	2,210,632	4,576,600	-	86,085,530	
Total energy use in electricity (GJ)	62,281,416	54,507,024	-	-	-	-	2,210,632	4,576,600	-	123,575,673	
Electricity Produced (GJ equivalent)											
Residential	3,206,809	-	-	-	-	-	-	-	-	3,206,809	
Commercial	2,153,827	-	-	-	-	-	-	-	-	2,153,827	
Industrial	3,541,849	13,140	-	-	-	-	-	-	-	3,554,989	
Agricultural	382,903	-	-	-	-	-	-	-	-	382,903	
Other	287,177	-	-	-	-	-	-	-	-	287,177	
EdL	10,011,474	17,303,839	-	-	-	-	1,132,949	4,576,600	-	33,024,862	
Total Electricity Produced (GJ)	19,584,039	17,316,979	-	-	-	-	1,132,949	4,576,600	-	42,610,568	
EdL conversion losses	14,821,673	37,161,311	-	-	-	-	1,077,683	-	-	53,060,667	
Private gen conversion losses	27,875,704	28,734	-	-	-	-	-	-	-	27,904,438	
Total Conversion Losses	42,697,377	37,190,045	-	-	-	-	1,077,683	-	-	80,965,106	

Note: LPG = liquefied petroleum gas; GJ = Gigajoul; kWh = kilowatt hour; EdL = Electricité du Liban.
Source: CEPCO, 2004.

Table A-5. Lebanon Tabular Energy Balance, 2002

	Gas Oil	Fuel Oil	Gasoline Leaded (98)	Gasoline Unleaded (90)	Jet Kerosene	LPG	Hydro	Electricity Import (Syria)	Other Fuels	Total (GJ)	
Sources of Primary Energy (GJ)											
Imports (Tons)	1,664,815	1,583,441	83,500	1,096,874	126,825	119,769	-	-	-		
GJ/ton	43	40	45	45	45	47	-	-	20		
Imported Electricity (kWh)	-	-	-	-	-	-	-	462,672,336	-		
Indigenous Production: Electricity (kWh)	-	-	-	-	-	-	645,696,408	-	-		
Other energy (Tons)	-	-	-	-	-	-	-	-	100,000		
Energy Supply GJ equivalent	72,142,061	63,643,687	3,740,696	48,873,592	5,655,053	5,666,372	4,535,624	1,665,620	2,000,000	207,922,706	
Fuel proportion in total	35%	31%	2%	24%	3%	3%	2%	1%	1%	100%	
Uses of Primary Energy (GJ)											
Residential	2,730,385	-	-	-	-	4,249,779	-	-	670,000	7,650,164	3.7%
Residential Space Heating	1,059,661	-	-	-	-	-	-	-	-	1,059,661	0.5%
Commercial	1,833,841	-	-	-	-	566,637	-	-	450,000	2,850,478	1.4%
Commercial Space Heating	711,712	-	-	-	-	-	-	-	-	711,712	0.3%
Industrial	3,015,650	13,866,846	-	-	-	849,956	-	-	740,000	18,472,452	8.9%
Agricultural	326,016	-	-	-	-	-	-	-	80,000	406,016	0.2%
Transport	5,794,791	-	3,740,696	48,873,592	5,655,053	-	-	-	-	64,064,132	30.8%
Other	244,512	-	-	-	-	-	-	-	60,000	304,512	0.1%
EdL (GJ)	11,301,239	15,329,602	-	-	-	-	1,975,831	1,415,777	-	30,022,450	14.4%
Petroleum Refineries	-	-	-	-	-	-	-	-	-	-	0.0%
EdL Conversion Losses	19,395,603	31,713,281	-	-	-	-	2,211,116	-	-	53,320,000	25.6%
Private Gen Conversion Losses	23,734,314	28,734	-	-	-	-	-	-	-	23,763,048	11.4%
Transmission Losses	1,994,336	2,705,224	-	-	-	-	348,676	249,843	-	5,298,079	2.5%
Intermediate Energy Use: Primary Energy in Electricity											
Energy in Electricity Production (GJ)											
Residential	10,681,381	-	-	-	-	-	-	-	-	10,681,381	
Commercial	7,174,062	-	-	-	-	-	-	-	-	7,174,062	
Industrial	11,797,346	41,874	-	-	-	-	-	-	-	11,839,220	
Agricultural	1,275,389	-	-	-	-	-	-	-	-	1,275,389	
Other	956,542	-	-	-	-	-	-	-	-	956,542	
EdL	32,691,179	49,748,107	-	-	-	-	4,535,624	1,665,620	-	88,640,529	
Total energy use in electricity (GJ)	64,575,897	49,789,981	-	-	-	-	4,535,624	1,665,620	-	120,567,122	
Electricity Produced (GJ equivalent)											
Residential	2,730,385	-	-	-	-	-	-	-	-	2,730,385	
Commercial	1,833,841	-	-	-	-	-	-	-	-	1,833,841	
Industrial	3,015,650	13,140	-	-	-	-	-	-	-	3,028,790	
Agricultural	326,016	-	-	-	-	-	-	-	-	326,016	
Other	244,512	-	-	-	-	-	-	-	-	244,512	
EdL	13,295,575	18,034,826	-	-	-	-	2,324,507	1,665,620	-	35,320,529	
Total Electricity Produced (GJ)	21,445,980	18,047,966	-	-	-	-	2,324,507	1,665,620	-	43,484,074	
EdL conversion losses	19,395,603	31,713,281	-	-	-	-	2,211,116	-	-	53,320,000	
Private gen conversion losses	23,734,314	28,734	-	-	-	-	-	-	-	23,763,048	
Total Conversion Losses	43,129,917	31,742,015	-	-	-	-	2,211,116	-	-	77,083,048	

Note: LPG = liquefied petroleum gas; GJ = Gigajoul; kWh = kilowatt hour; EdL = Electricité du Liban.
Source: CEPCO, 2004.

Annex 3: Future Electricity Demand

Limitations of the Data

The Consultants'[59] preferred approach to demand forecasting would have been to prepare econometric equations to obtain demand and price elasticities for each of the major demand sectors. The following factors, however, should be considered:

- EdL was not able to provide consumption statistics by customer category.
- EdL faces supply constraints that create suppressed demand (so that actual demand is greater than electricity supplied).
- There is a significant but unmeasured self-generation component to the electricity supply in Lebanon.
- The war in Lebanon led to the interruption of national data collection and many statistical records for this and the post-war period do not exist. Although more recent national accounts are being produced, they were not available in time for use in this study.

These data limitations place major constraints on the base data on which the demand forecast was made. The forecasting approach and assumptions are set out below.

Introduction

The electricity demand forecast is based on sectoral demand categories: Residential, Industrial, Commercial, Agricultural, and Other. The base year for the projections is 2002.

The approach taken to estimating base-year demand (the starting point for the projections) begins from the supply data metered at EdL[60] station fences (referred to as "sent-out"). Total EdL sent-out generation in 2002 was 9,811 GWh.

The total EdL supply is made up of the following components:

- Actual generation at the EdL station fence,
- Purchases from concessions in Lebanon, and
- Purchases from Syria.

Suppressed Demand

In addition to the EdL sent-out generation, the forecast takes account of suppressed demand from customers who are supplied by EdL but whose supply is interrupted at certain times because of power plant outages, fuel shortages, or transmission constraints. EdL's data show that, on average, suppressed demand in 2002 was 8.84 percent of total demand on the EdL interconnected system. This gives an additional equivalent sent-out demand in the base year of 951 GWh. Adding this to EdL's actual sent-out

[59] The electricity demand forecasts was undertaken by CEPCO.
[60] The system data included purchases from concessions and from Syria.

generation of 9,811 GWh in 2002, the total EdL station fence demand in 2002 would have been 10,763 GWh, if there had been no supply constraints.

Self-Generation

It is anticipated that some of EdL's suppressed demand is, at least in part, supplied by diesel self-generators. Self-generation is provided by small- and medium-size diesel generators supplying a range of commercial, industrial, and agricultural users, as well as residential streets and single households.

The grid-supplied equivalent to self-generation[61] from diesel generation-sets was calculated for the base case as 1,995 GWh. The 951 GWh of EdL suppressed demand is assumed to be covered by diesel gen-sets and subtracted from 1,995 GWh. The resulting self-generation is then 1,044 GWh. Self-generation from fuel oil–powered plants was estimated at only 2 GWh.

The estimated total EdL and self-generation values were 11,808 GWh in 2002.

Sectoral Electricity Consumption Breakdown

There is no sectoral electricity demand breakdown available for Lebanon and the split between consumption categories was estimated using Greece as a comparison country. Greece was selected for its similar climate and income characteristics.[62] To account for the difference in development between Lebanon and Greece, the 1994 Greek sectoral figures were used as a starting point and were adjusted to reflect variations in the structural makeup of the economy.[63] The sectoral proportions are given in Table A-6.

Table A-6. Sectoral Consumption Split

Sector	Percentage Share
Residential	33.5
Commercial	22.5
Industrial	37.0
Agricultural	4.0
Other	3.0

Source: CECPO 2004.

Losses

All future reductions in *technical* losses represent reductions in the MWh that need to be generated by EdL. However, reductions in nontechnical losses (theft, meter errors, and so on) may be converted into increased sales revenues without any change to the MWh generated by EdL. In other words, those customers who were previously not paying for their electricity become paying customers and continue to consume electricity. This makes it necessary to calculate the net reduction to the MWh demand that would results from a successful loss reduction program.

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[61] Reflecting the transmission and distribution losses that would occur for grid generation that would not occur for self-generation.

[62] Although Greece has a slightly higher per capita gross domestic product (GDP) than Lebanon, the comparison with Greece was thought to give a better indication than with neighboring Arab countries.

[63] Lebanon has a lower proportion of agriculture and a higher proportion of construction in GDP than Greece.

Nontechnical losses are assumed to apply only to EdL supply (and not to self-generation where electricity is assumed to be generated close to the source). For this reason, the EdL component was forecast separately from self-generation.

Each case uses a different loss reduction rate. These are given in Table A-7 below. Nontechnical loss reductions were calculated on the reduction from the EdL base supply in the previous year using a conversion-to-sales rate of 50 percent. These were then apportioned among customer categories according to the proportion of total sales in the previous year.

Technical losses in transmission and distribution in Lebanon are currently estimated at around 15 percent compared with an average of 10–12 percent in the Middle East and much lower in Western industrialized countries. Technical losses in Lebanon can be expected to decrease as the transmission and distribution networks are rehabilitated. The factors applied to the forecasts are also given in Table A-7.

Table A-7. Technical and Nontechnical Loss Reduction Rates

	Base Case		Low Case		High Case	
	Technical	*Non-technical*	*Technical*	*Non-technical*	*Technical*	*Non-technical*
Start	15% in 2002	25% in 2002	15% in 2002	25% in 2002	15% in 2002	25% in 2002
Reduction rate	0.5% per year from 2004	2% per year from 2004	1% per year from 2004 and 0.5% in 2008	3% per year from 2004	0.25% every year from 2004	1% every year from 2004
Stabilizing	10% in 2013	5% in 2013	9.5% in 2009	4% in 2010	10.75% in 2020	8% in 2020

Source: CEPCO 2004.

Forecast Methodology

Each of the major customer categories was forecasted separately, using assumed elasticities, before being aggregated to give total MWh sales. Technical and nontechnical losses are added to give total sent-out electricity demand. This figure is then converted to MW maximum demand using load factors and coincidence factors.

MWh Sales

The general form of the forecasting equations is illustrated by the residential demand equation:

$$R_t = \left(\varepsilon_r^i \times \Delta GNP_t\right) \times \left(\varepsilon_r^p \times p_t\right) \times R_{t-1} \times \alpha$$

where:

R_t = Residential demand in period t

ε_r^i = Residential income elasticity of electricity

ΔGNP_t = Growth in GNP in period t

ε_r^p = Residential price elasticity of electricity

p_t = Indexed electricity price change

R_{t-1} = Residential demand in period t-1

α = a factor for nontechnical loss reductions net of conversions to sales

The methodology applied to the residential forecast differs from that used for the remaining sectors in that it incorporates gross national product (GNP) rather than gross domestic product (GDP). GNP takes into account total income generated within the economy plus the net income earned by Lebanon overseas. The Lebanese economy currently runs a significant trade deficit and is highly dependent on inward transfers to finance this debt. These incomes are made up of contributions from expatriate Lebanese and direct foreign investment.

The income effect in residential demand is based on GNP. The inward transfers directly affect the household budget constraint and, thus, the ability of households to spend on consumption goods such as air conditioning units and home appliances. This in turn affects electricity demand. The remaining sectors are affected by GDP, which measures the total value of goods and services produced *within* the economy (that is, excluding net income from investments abroad). Implicit in the GDP forecast is an account of the impact of future direct foreign investment.

Ideally, each of the nonresidential sector's electricity demand would be based on growth in GDP for that sector (for example, service sector GDP would be used in the equation for commercial electricity demand). However, as sectoral GDP breakdowns are not available for Lebanon, total GDP is used as a proxy under the assumption that there is no change in the underlying economic structure over the forecast period. The "other" sector is a residual, including uses such as street lighting.

Peak Demand (in MW)

Forecast total peak demand, including losses, is the aggregate of each of the sector forecasts weighted by an assumed coincident load factor[64] and adjusted to account for the incidence of higher losses at the peak:

$$D_t = \left[\left(R_t \times l_r\right) + \left(C_t \times l_c\right) + \left(I_t \times l_i\right) + \left(A_t \times l_a\right) + \left(O_t \times l_o\right)\right] \times \lambda$$

where,

D_t = total forecast peak demand (MW) in year t

R_t = average hourly forecast residential demand (MW) at the station fence in year t

C_t = average hourly forecast commercial demand (MW) at the station fence in year t

I_t = average hourly forecast industrial demand (MW) at the station fence in year t

A_t = average hourly forecast agricultural demand (MW) at the station fence in year t

O_t = average hourly forecast "other" demand (MW) at the station fence in year t

l = sector coincident load factor

λ = adjustment for higher losses at the peak

Scenarios

Three forecast cases were prepared to give a wider range of the possible paths of future electricity demand in Lebanon:

- Base-case assumptions

[64] The actual average EdL system load factor in 2002 was around 80 percent. While this reflects Lebanon's relatively flat demand profile, it also demonstrates the peak-clipping impact of EdL suppressed demand. The forecast load factor of 67 percent includes non-EdL (peak-meeting) generation.

- High-demand assumptions
- Low-demand assumptions

The assumptions underlying each scenario are given below.

(a) Base-Case Assumptions

GDP and GNP growth rates—GDP forecasts for Lebanon beyond a five-year horizon are not available. The International Monetary Fund (IMF) forecast of Real GDP growth for Lebanon in the years 2003 and 2004 is 3 percent.[65] However, unofficial World Bank estimates are more conservative at around 1.5–2 percent and a middle rate between these estimates was chosen for the forecast.

Elasticities—The lack of historic data prohibits the estimation of income and price elasticities for Lebanon. The approach here was to use generally accepted elasticities previously estimated for similar countries with adjustments made as appropriate for the Lebanese economy. These are shown in Table A-8.

Table A-8. Elasticity Assumptions

Sector	Elasticity
Income Elasticities	
Residential	1.3
Commercial	1.2
Industrial	1.2
Agricultural	1.1
Other	1.2
Price Elasticity	
All Sectors	-0.2

Change to Real Electricity Prices—The current tariff schedule in Lebanon is unlikely to be a true reflection of system costs and is likely to change in the future. Residential and consumer tariffs are anticipated to rise, but industrial tariffs are expected to fall. The model assumes that industrial prices drop in 2004–06 and are held constant in 2007. Prices to the remaining sectors were allowed to rise up to the year 2010.

Sectoral Load and Coincident Factors—The load and coincident factors for each sector are difficult to establish because of the absence of load research data. There are also deficiencies in EdL records and uncertainties regarding suppressed demand. Residential load tends to peak in the evening, making it coincident with Lebanon's evening peak in total load. Industrial load will follow a relatively more stable load profile with slightly higher use during the day because of administrative support and cooling load. It is likely to be less coincident with total load. Commercial and agricultural load will follow a similar profile with higher demand during the day. Their coincidence is likely to be lower than for industrial load. A similar factor will apply for the "other" category.

Loss Reduction Factors—Technical and nontechnical losses for the EdL system are currently estimated at 15 and 28 percent, respectively. EdL has indicated that, with the rehabilitation of the transmission and distribution systems, technical losses will fall to approximately 10 percent. The rate at which these losses are reduced was assumed in the model as described in Table A-7 above.

Residential Demand—As individual wealth grows, residential electricity demand is expected to experience a high growth initial "catch-up" period. During this catch-up phase, purchases of household

[65] World Economic Outlook. 2003. "Statistical Appendix."

appliances, such as air conditioners, will be high as households replenish their stocks and shift toward an industrialized-world level of electricity consumption. The high-growth phase will eventually plateau with the attainment of a base level of wealth. At this stage, Lebanon's income elasticity of electricity demand will settle to a lower long-run level as is seen in industrialized countries. The high initial growth in residential demand was reflected in the model as a higher-income elasticity in the early years.

Industrial Consumers—The major industrial consumers of petroleum products are cement, ceramics, glass, food and beverages, fabricated metal products, furniture rubber and plastics, machinery, and pulp and paper. Of these, the significant users for electricity generation purposes will be the cement industry.

The Sibline cement plant generates up to 2 MW using gas oil. The other large cement factory, Societe des Ciments Libanais, generates 2.5 MW using fuel oil. The total generation from the fuel oil (FO) generator is calculated on the assumption that it operates only during the four-hour night peak period[66] when EdL tariffs are at their highest, with an allowance for the assumed coverage of EdL load shedding by diesel generators.

Construction activities as measured by deliveries of cement fell by 4.6 percent in 2002 and remain variable in 2003.[67] However, by contrast, applications for construction permits increased 36 percent in 2002, suggesting a positive outlook for future construction activity. With the fading of the post-war reconstruction boom activity in the construction industry is expected to converge toward GDP growth rates.

Lebanon is currently negotiating accession to the World Trade Organization (WTO). Upon entry to the WTO, it is likely that the country will be required to relax or remove the import restrictions that currently sustain the domestic cement industry.[68] Improvements in fuel efficiency resulting from centralized electricity supply and the introduction of natural gas are likely to be balanced by the effects of open competition from foreign producers. The electricity consumption of domestic cement manufacturers is therefore expected to remain steady or to decline.

Tourism Sector Growth—The passenger arrival data for Beirut International Airport over the period 1998–2002 suggest that tourist numbers have been rising at approximately 6 percent per year.[69] On this basis, up to the year 2015, a 1 percent premium is added to the GDP forecast used for the commercial sector to approximate the impact of higher growth from the tourism sector.

Energy Efficiency—Lebanon is currently in the initial stages of developing an energy efficiency policy. Early analysis suggests that the country is well suited to the application of solar water heating and that there are opportunities for efficiency gains from building insulation, appliance efficiencies, and improvements in the power factors of industrial processes. Although at this early stage it is not possible to incorporate accurate forecasts of the impacts of energy efficiency gains, the model acknowledges their potential through the income elasticities of demand for the commercial, industrial, and residential sectors. In 2010, these gains are each decreased by 0.05 in each case.

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[66] The night peak tariff for medium-voltage customers in the current EdL tariff schedule is 320 Lebanese Pound per kilowatt hour (LL/kWh) (i.e., $0.21/kWh, above the calculated average cost of private self-generation) from 16:30 to 20:30.

[67] Banque du Liban. Quarterly Bulletin Fourth Quarter 2002; Monthly Bulletin May 2003.

[68] Lebanon operates an open trade policy on most goods and services but retains protective policies for cement and steel cables.

[69] Ibid., 6

(b) High-Demand Assumptions

The assumptions for the high-demand forecast case had the following differences from the base-case assumptions described above:

- GDP was assumed to grow at 6 percent in 2003, falling to 5.25 percent in 2010, and 3.5 percent in 2020;
- GNP grew at 6.5 percent in 2003, falling to 5.45 percent in 2010, and 3.7 percent in 2020;
- Technical losses decrease at a lower rate;
- Nontechnical losses decrease at a lower rate;
- The premium for tourist sector growth was increased by 0.5 percent in the years 2003–15; and
- Self-generation in the base year was calculated based on a lower fuel consumption rate of 300g/kWh. This results in a higher total initial self-generation amount of 2267GWh.

(c) Low-Demand Assumptions

The assumptions for the low-demand forecast case had the following differences from the base-case assumptions described above:

- GDP grew at 2 percent in 2003, falling to 1.5 percent in 2007, 1.3 percent in 2011 and ending in 1.2 percent in 2020;
- GNP was assumed to grow at 2.5 percent from 2003, falling to 2.0 percent from 2009, 1.8 percent from 2011 ending at 1.7 percent in 2020;
- Technical loss reduction progressed quicker;
- Nontechnical losses reduced quickly;
- The premium for tourist sector growth was reduced to 0.5 percent in the years 2003–10; and
- Self-generation in the base year was calculated based on a higher fuel consumption rate of 350g/kWh. This resulted in a higher total initial self-generation figure of 1944GWh.

Results

The results of the demand forecast for each case are summarized in Table A-9 below. Growth figures for 2002–05 are per annum and for 2010–20 are five-year averages.

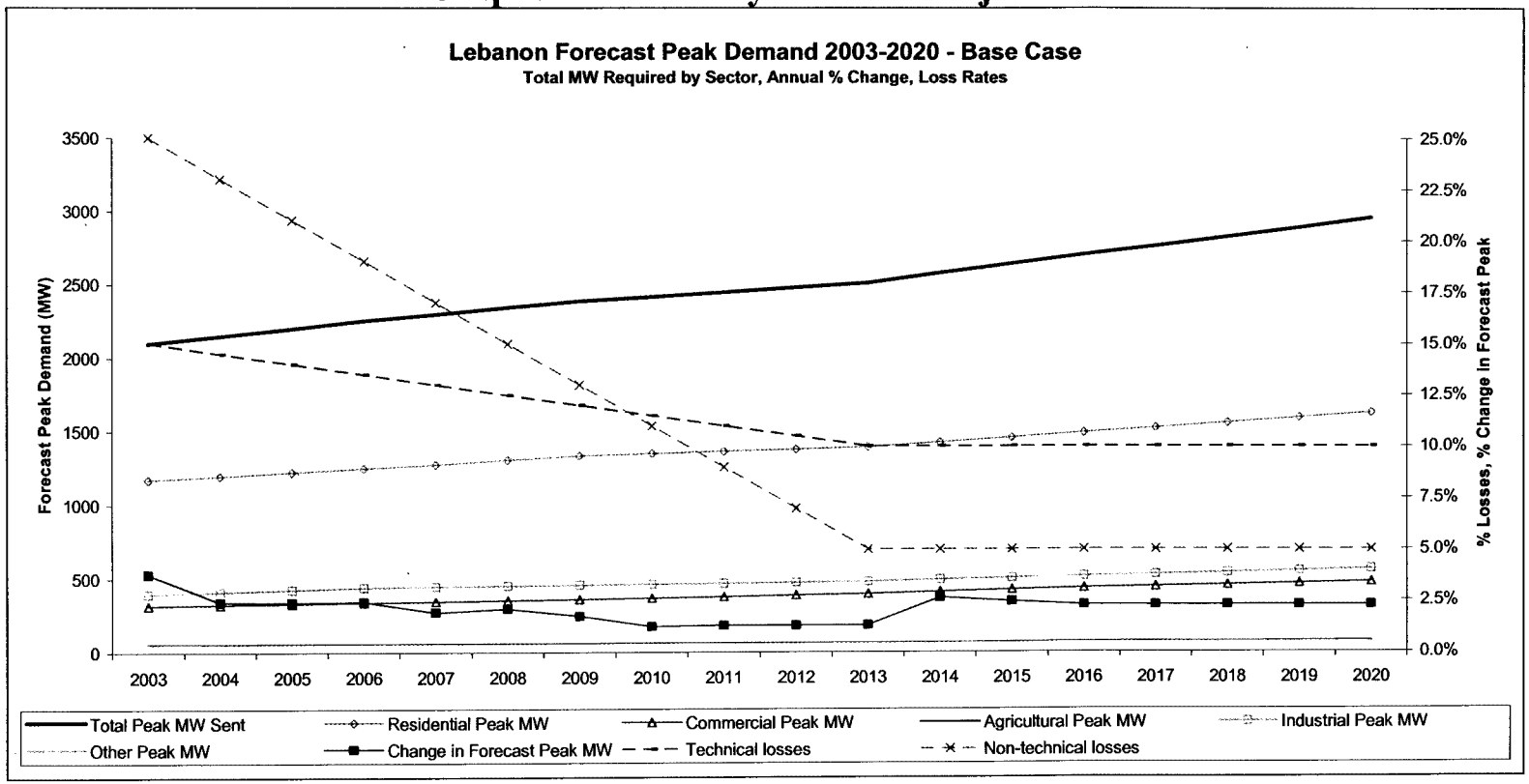
Table A-9. Electricity Peak Demand Forecast (in MW)

	2004	2005	2010	2015	2020
Base Case	2,149	2,201	2,419	2,644	2,961
% Growth	*2.4*	*2.4*	*1.9*	*1.8*	*2.3*
Low Case	2,048	2,050	2,051	2,225	2,401
% Growth	*0.1*	*0.1*	*0.0*	*1.6*	*1.5*
High Case	2,362	2,528	3,412	4,398	5,110
% Growth	*7.0*	*7.0*	*6.2*	*5.2*	*3.1*

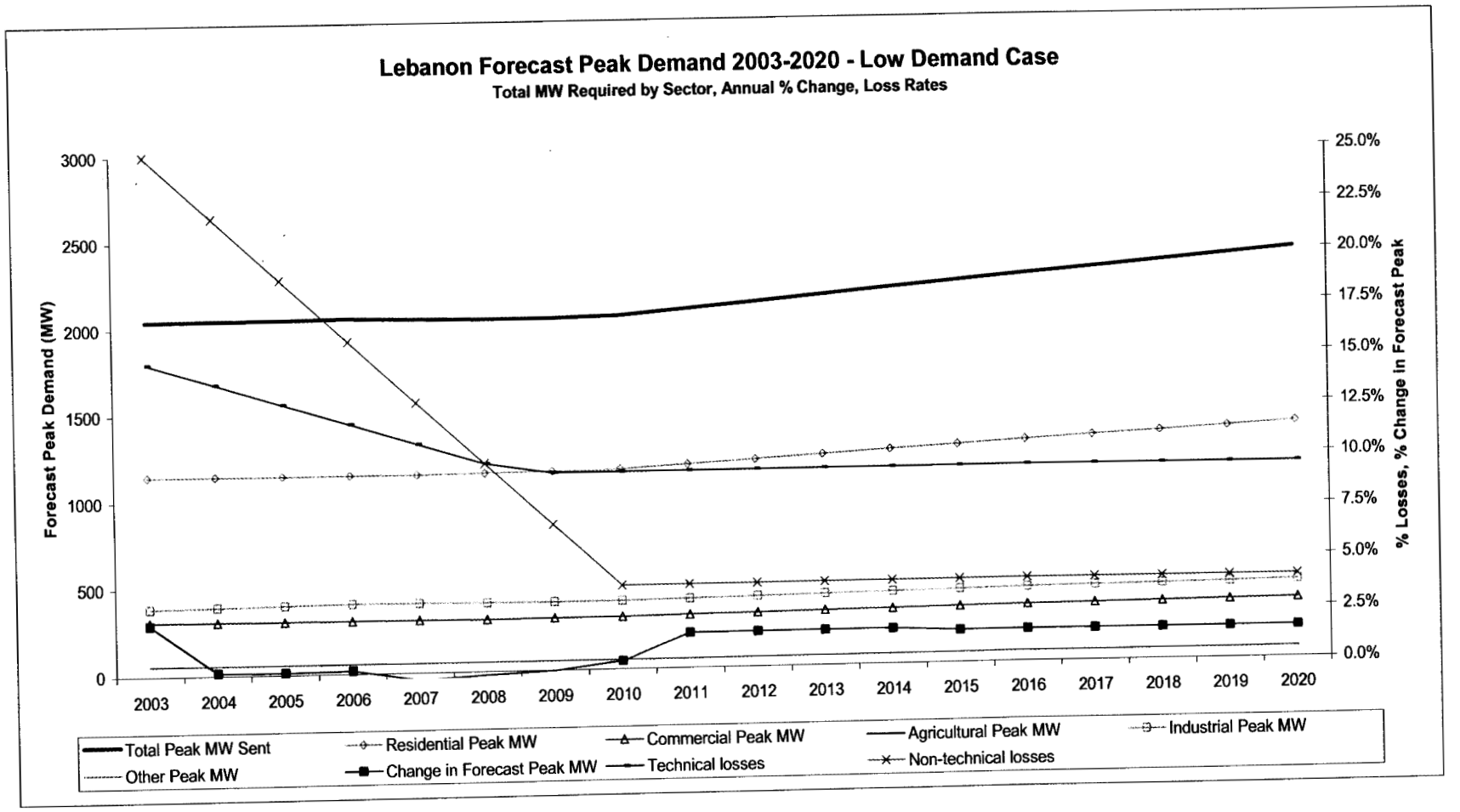
Note: MW = megawatts. Growth figures until 2005 are per year and for the period 2005–20 are five-year averages.
Source: CEPCO 2004.

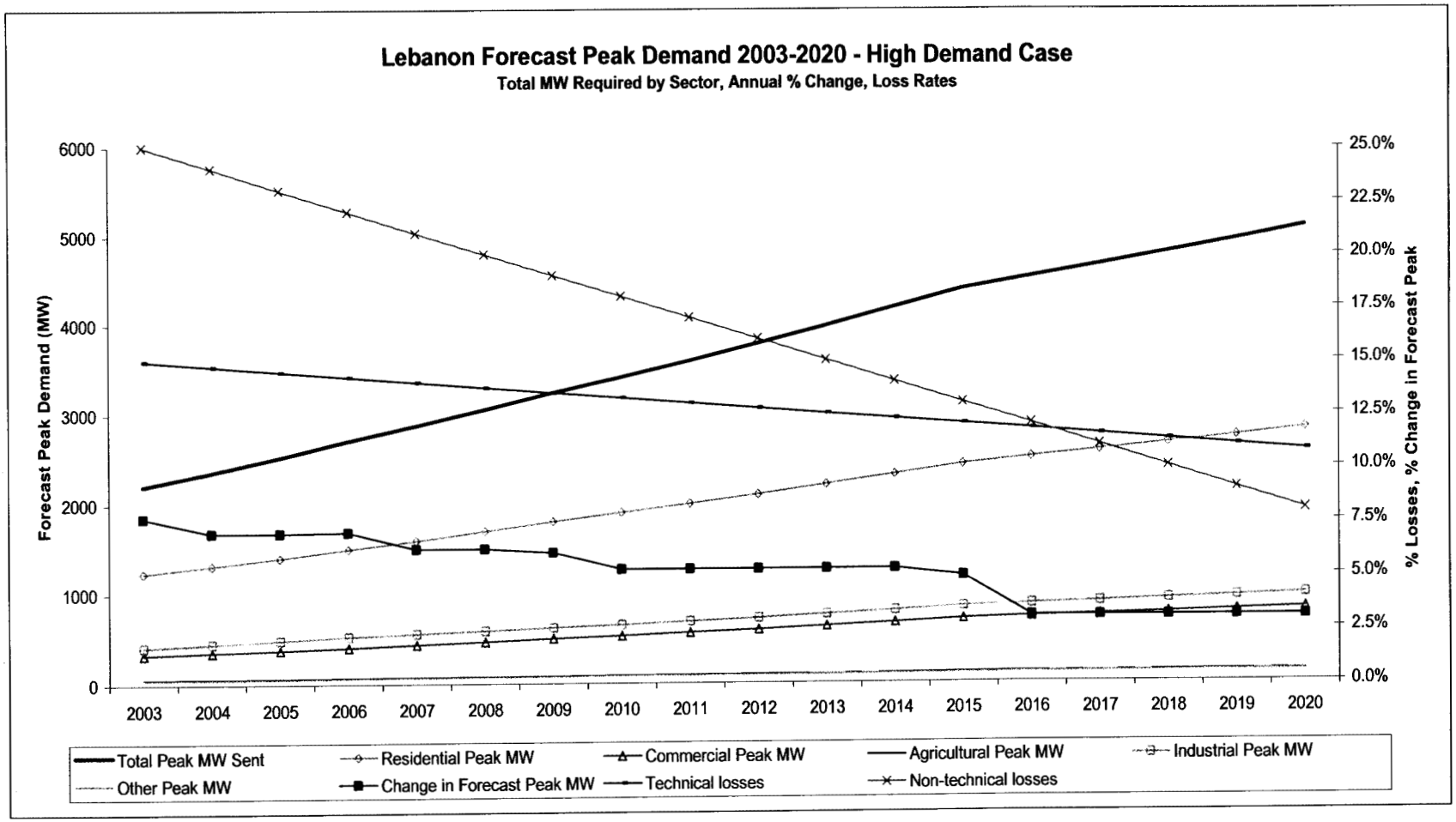
The graphs below show peak demand forecasts until 2020 for the various demand scenarios for each customer group.

Graphs of Electricity Demand Projections



Note: MW = megawatts.
Source: CEPCO, 2003


Lebanon Forecast Peak Demand 2003-2020 - Low Demand Case
Total MW Required by Sector, Annual % Change, Loss Rates
Forecast Peak Demand (MW)
% Losses, % Change in Forecast Peak
3000
2500
2000
1500
1000
500
0
25.0%
22.5%
20.0%
17.5%
15.0%
12.5%
10.0%
7.5%
5.0%
2.5%
0.0%
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Total Peak MW Sent
Residential Peak MW
Commercial Peak MW
Agricultural Peak MW
Industrial Peak MW
Other Peak MW
Change in Forecast Peak MW
Technical losses
Non-technical losses


Lebanon Forecast Peak Demand 2003-2020 - High Demand Case
Total MW Required by Sector, Annual % Change, Loss Rates
Forecast Peak Demand (MW)
% Losses, % Change in Forecast Peak
6000
5000
4000
3000
2000
1000
0
25.0%
22.5%
20.0%
17.5%
15.0%
12.5%
10.0%
7.5%
5.0%
2.5%
0.0%
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Total Peak MW Sent
Residential Peak MW
Commercial Peak MW
Agricultural Peak MW
Industrial Peak MW
Other Peak MW
Change in Forecast Peak MW
Technical losses
Non-technical losses

Annex 4: Analysis of Non-Power Sector Demand

Annex 4 analyzes the potential for natural gas use outside the power sector. The principle method used to estimate natural gas demand is *netback analysis*. This analysis was undertaken by Chubu Electric Power Company Ltd. (CEPCO).

The demand for natural gas depends on its price relative to other fuels. If a new fuel becomes available at a lower price then users will eventually switch to that fuel. *Netback analysis* estimates the demand for natural gas by different types of user over a range of prices. With this type of analysis there is no single point estimate of demand but, rather, different levels of demand at different prices. The single point estimate of demand can be found when the gas price is known. Netback values are normally calculated relative to *competing fuels* in *specific uses*, such as electricity or liquefied petroleum gas (LPG) (the fuels) used for cooking (the use).

It should be noted that the demand curves calculated using netback analysis show the *potential demand* at each price, but the actual demand will be affected by a range of factors, including inertia by consumers in switching, lack of information, uncertainty over the future prices of gas and competing fuels, the age and condition of existing energy using installations, and others. The following sections present the assumptions made for estimating potential gas demand in the residential, commercial, and industrial sectors.

Residential and Commercial Sectors

Lebanon enjoys a moderate climate with some air conditioning load in the summer but limited heating in the winter. There are two main potential sources of demand for natural gas in the residential and commercial sectors: cooking and space heating.

The source of fuel for residential and commercial cooking is primarily bottled LPG. Fuel for residential heating is largely gas oil. Natural gas could be substituted for these fuels, but this would require the development of a gas pipeline network to deliver the gas to users. Lebanon's mild winters mean that heating season, if any, is rather short and the demand for gas for space heating would be small. The same is true of the commercial sector that might use natural gas for space heating or in restaurants and hotels for cooking. Lebanon's mountainous topography would add to the cost of building and operating a local gas distribution system.

It is therefore unlikely that there would be a viable market for piped natural gas for use in the residential and commercial sectors in Lebanon. Based on delivered cost, alternative fuels are likely to be more economic. Even if the market is viable, the levels of demand would be low and the net benefits would be marginal. This leaves the industrial sector as the most promising non-power demand for natural gas.

Industrial Sector

The industrial sector in Lebanon currently uses gas oil and fuel oil to generate electricity in small generation-sets and in furnaces and boilers. It is assumed that self-generation load will migrate back to EdL's grid supply by 2007 when the system is fully rehabilitated. This means that demand for a large portion of the gas oil and some fuel oil currently used by industry will be replaced by natural gas (used for power generation by EdL). As a result, there is little potential demand for natural gas that arises from direct substitution of these fuels in the industrial sector (although there is substantial potential for indirect demand for gas through the power sector).

The main fuels for industrial boilers are LPG and fuel oil. The analysis of *non-power* sector natural gas demand therefore concentrates on substitution of these fuels in the Lebanese industrial sector.

Traditionally, the Lebanese economy has been composed largely of services and intermediate industries. The country does not have a significant base of heavy industry, although some does exist in certain sectors. The industrial and agricultural sectors only contribute around 20 percent to gross domestic product (GDP).

Of the heavy industry that exists in Lebanon, the most energy intensive are cement, fabricated metals, paper, glass, ceramics, and rubber and plastics. The cement industry is a potential customer of natural gas primarily for use in furnaces. Currently, it is sustained by protection against imports. There are four paper recycling mills using diesel oil and two glass plants using heavy fuel oil (HFO). However, both the paper and glass industries are said to be in, or nearing, financial difficulty. The ceramics plant imports LPG at high cost for use in its furnaces.

Assumptions

The netback analysis is based on current and forecast price and volumes of LPG and three grades of HFO (standard, and 1 percent and 2 percent sulfur fuel oil). All fuel volumes were converted into their million cubic meters (MMCM) equivalent values to ease comparison with other parts of the study.[70]

The underlying price forecasts for crude oil were based on the Energy Information Administration 2003 forecast.[71] Prices for petroleum products were obtained from the Petroleum Directorate and an annual price for 2002 derived as a time-weighted average. Forecast prices of petroleum products were linked to international crude prices. Product prices were converted to US$/million British thermal units (mmbtu) to enable comparison[72] with natural gas prices.

Other assumptions (for example, GDP) underlying the forecasts of demand for each fuel are consistent with those used in the electricity demand forecast.

Results

The aggregate demand relates to factors such as GDP growth. Each result gives price and quantity combinations for natural gas for the corresponding year and forecast growth scenario (base, low, and high).

The price of natural gas delivered to users in Lebanon plays a role in estimating the demand for gas. The price for Syrian gas delivered to Bedawwi has been quoted as US$2.70/mmbtu.[73] The bulk price of Egyptian gas is expected to be higher than this at approximately US$2.94/mmbtu, while Iraqi gas should be cheaper and possibly as low as US$2/mmbtu. The price delivered to industrial (and other) consumers would need to include add-on costs for transmission and distribution. Indicative data from other countries suggests an average *distribution* margin, for a mixture of residential and industrial customers with a relatively dense gas demand, of US$1–1.3/mmbtu; however, specific factors in Lebanon would affect the margin:

- Beirut would have a relatively low density of demand, which would tend to make costs higher than US$1–1.3/mmbtu,

[70] To convert to million British thermal units (mmbtu) multiply the MMCM value by 36.9642.
[71] Environmental Impact Assessment. 2003. *Annual Energy Outlook*, Table 15.
[72] To convert to $/MMCM multiply the $/mmbtu value by 36.9642.
[73] This price is based on a crude oil price of $20/barrel, which is below the base- and high-case crude oil price forecasts used in the netback analysis.

- In contrast, most customers in Beirut would be industrial, which would tend to make average costs lower than US$1–1.3/mmbtu,
- The figure of US$1–1.3/mmbtu excludes transmission; if transmission costs are added, then the margin to add to the bulk price would be higher than US$1–1.3/mmbtu.

Taking account of these factors, a transmission and distribution margin of US$1–1.3/mmbtu was assumed. The indicative delivered price of gas would be between US$4.5 and US$4.8/mmbtu in 2010, if gas is from Egypt, and between US$3.4 and US$3.7/mmbtu, if gas is from Iraq. The prices increase with time because of the assumed increase in international oil prices. The resulting price ranges are given in the table below:

Table A-10. Range of Gas Prices Delivered to Industry (US$/mmbtu)

	2010	2015	2020
Natural Gas:			
Egyptian Gas	4.5–4.8	4.6–4.9	4.7–5.0
Iraqi Gas	3.4–3.7	3.5–3.8	3.5–3.8
Other Fuels:			
Fuel Oil 1% Sulfur	4.3	4.4	4.6
Heavy Fuel Oil	3.6	3.7	3.8
LPG	12.2	12.5	12.9

Note: mmbtu = million British thermal units ; LPG = liquefied petroleum gas.
Source: CEPCO 2004.

The netback analyses indicate that the cost of burning LPG is high and suggests that there certainly could be demand for natural gas from these users, in the range of 36 to 60 MMCM per year by 2020 (0.10 to 0.17 MMCM/day) in the low and high cases, respectively, even at high delivered gas prices.

In conclusion, there is a demand for natural gas to substitute LPG. The demand for gas in the base and high scenarios, for Egyptian and Iraqi gas, is shown in the table below.

Table A-11. Non-Power Gas Demand (MMCM/day)

	Egyptian Gas			Iraqi Gas		
	2010	2015	2020	2010	2015	2020
Base Case						
LPG	0.08	0.09	0.10	0.08	0.09	0.10
1% Sulfur	0.00	0.00	0.00	0.61	0.69	0.78
2% Sulfur	0.00	0.00	0.00	0.09	0.11	0.12
HFO	0.00	0.00	0.00	0.57	0.65	0.73
Total	**0.08**	**0.09**	**0.10**	**1.36**	**1.54**	**1.72**
High Case						
LPG	0.10	0.14	0.17	0.10	0.14	0.17
1% Sulfur	0.81	1.08	1.30	0.81	1.08	1.30
2% Sulfur	0.13	0.17	0.20	0.13	0.17	0.20
HFO	0.76	1.01	1.21	0.76	1.01	1.21
Total	**1.80**	**2.40**	**2.87**	**1.80**	**2.40**	**2.87**

Note: MMCM = million cubic meters; LPG = liquefied petroleum gas; HFO = heavy fuel oil.
Source: CEPCO 2004.

The table above suggests that the substitution of 1 percent sulfur fuel oil would be attractive to users. This would give an annual demand from fuel oil substitution in the range of 0.6 to 1.3 MMCM/day (base case/Egyptian gas, 2010, and high case/Iraqi gas, 2020, respectively).

Substitution of 2 percent sulfur fuel oil is shown to be attractive if the price of gas is low (for example, Iraqi gas) or if the high case is followed (except in the combination of base case and Egyptian gas). However, substitution of 2 percent sulfur fuel oil gives rise to relatively low levels of demand. Similarly, substitution of gas for high sulfur fuel oil would be attractive under the same circumstances but would lead to a more substantial gas demand between 0.57 and 1.21 MMCM/day.

Overall, the non-power gas demand in 2010 is shown in the table above to range from 0.69 to 1.8 MMCM/day. It is possible that gas demand may increase among industrial users if more stringent environmental regulation is introduced, which would require greater use of expensive low sulfur content fuel oil.

Conclusions: Non-Power Gas Demand

The supply of gas to households and commercial premises is unlikely to be economical in Lebanon because of the cost of constructing a local gas distribution network to serve low-volume demands. This means that non-power sector natural gas demand is likely to be limited to industrial customers. However, Lebanon's economy has traditionally been service oriented with a relatively small industrial sector.

Based on Egyptian gas delivered to end users at prices in the range of US$4.5–4.8/mmbtu in 2010 rising to US$4.7–5.0/mmbtu by 2020, we estimate the demand by industrial consumers in the base case as shown in table below.

Table A-12. Base-Case Aggregate Demand for Gas (MMCM/day)

	2010	2015	2020
Residential	minimal	minimal	minimal
Commercial	minimal	minimal	minimal
Industrial			
LPG Substitution	0.08	0.09	0.10
Substitution of Fuel Oil 1% Sulfur	0.00	0.00	0.00
Substitution of Fuel Oil 2% Sulfur	0.00	0.00	0.00
Substitution of Fuel Oil High Sulfur	0.00	0.00	0.00
Total	**0.08**	**0.09**	**0.10**

Note: MMCM = million cubic meters; LPG = liquefied petroleum gas.
Source: CEPCO 2004.

In the high case, with low Iraqi gas prices of US$3.4–3.7/mmbtu in 2010 rising to US$3.5–3.8/mmbtu in 2020, the demand for gas would be higher, as shown in Table A-13 below.

Table A-13. High-Case Aggregate Demand for Gas (MMCM/day)

	2010	2015	2020
Residential	minimal	minimal	minimal
Commercial	minimal	minimal	minimal
Industrial			
LPG Substitution	0.10	0.14	0.17
Substitution of Fuel Oil 1% Sulfur	0.81	1.08	1.30
Substitution of Fuel Oil 2% Sulfur	0.13	0.17	0.20
Substitution of Fuel Oil High Sulfur	0.76	1.01	1.21
Total	**1.80**	**2.40**	**2.87**

Note: MMCM = million cubic meters; LPG = liquefied petroleum gas.
Source: CEPCO 2004.

Annex 5: Petroleum Refining Capacity and Demand in the Mediterranean Region

	-	Refining Capacity					Demand					Import					Export				
		Crude Oil	Gasoline	Gas Oil	Fuel Oil	Other Products	Crude Oil	Gasoline	Gas Oil	Fuel Oil	Other Products	Crude Oil	Gasoline	Gas Oil	Fuel Oil	Other Products	Crude Oil	Gasoline	Gas Oil	Fuel Oil	Other Products
Egypt	1997	41,167	1,747	5,867	12,914	6,848	28,649	2,080	6,453	8,150	3,822	0	333	855	0	477	12,518	0	269	4,764	3,542
	2000	34,807	2,261	5,759	11,171	6,238	27,028	2,329	7,793	7,350	3,867	0	68	2,237	0	945	7,779	0	203	3,821	3,316
Syria	1997	30,186	1,591	4,088	5,216	1,276	12,719	1,142	4,692	3,566	1,411	0	0	604	0	268	17,467	449	0	1,650	133
	2000	27,337	1,579	4,061	5,200	1,284	12,708	1,247	5,160	4,248	1,593	0	0	1,099	0	436	14,629	332	0	952	127
Libya	1997	69,347	1,970	4,272	4,834	3,148	17,124	1,656	2,108	3,227	0	0	0	0	0	30	52,223	314	2,164	1,607	3,178
	2000	65,318	2,030	4,662	4,330	3,259	16,900	1,917	2,255	2,788	479	0	0	0	0	30	48,418	113	2,407	1,542	2,810
Saudi Arabia	1997	417,326	11,309	24,514	24,834	14,677	91,827	3,849	17,716	5,310	4,696	0	0	0	0	0	325,499	7,460	6,798	19,524	9,981
	2000	410,595	12,586	23,939	24,616	16,063	90,638	9,778	17,948	8,855	4,597	0	0	0	0	0	319,957	2,808	5,991	15,761	11,466
Turkey	1997	3,449	3,916	7,269	8,790	5,845	26,961	4,580	7,812	8,374	8,145	23,512	664	799	478	2,586	0	0	256	894	286
	2000	3,233	3,677	7,969	8,213	6,835	27,711	4,543	7,079	8,392	9,545	24,478	866	205	742	3,127	0	0	1,095	563	417
Lebanon	1997	0	0	0	0	0	0	1,310	1,387	1,870	342	0	1,310	1,387	1,870	342	0	0	0	0	0
	2000	0	0	0	0	0	0	1,264	1,316	1,507	389	0	1,264	1,316	1,507	389	0	0	0	0	0

Note: The supply and demand of petroleum products for 1997and 2000 are based on the latest edition of *Energy Statistics of Non-OECD Countries*, 2002, published by International Energy Agency.
Source: Energy Statistics of Non-OECD Countries 2002.

Annex 6: Inventory of Existing Laws that Affect the Lebanese Gas Market

Existing Lebanese Law, Decrees, and Ministerial Decisions Affecting the Gas Sector

Introduction

According to the Lebanese Constitution, legislation and lawmaking is the sole responsibility of the Lebanese Parliament, which issues what is called the **"Code–Law."** However, in a Code–Law, the Parliament can give the Government the authority to issue a bylaw for application of a specific Code–Law. This is referred to as a **"Decree–Law."** The Parliament can give the Government the authority to issue Decree–Law in specific sector and for a limited period of time without having recourse to the Parliament.

Code–Laws issued by the Parliament, and Decree–Laws issued by the Government, as the case may be, gives the concerned sector Minister the authority to issue the secondary legislation or bylaws clarifying the manner of implementation of the specific Code–Law or Decree–Law. These secondary legislation/bylaws are referred to as **"Ministerial Decisions/Regulations."**

Altogether, there are 13 existing legal instruments pertaining to, or related to, the hydrocarbons sector, of which 2 have an indirect bearing on the sector. These are the Lebanese-Syria Treaty and General Privatization Law. Below is a summary of each of the relevant Code–Laws, Decree–Laws, and Ministerial Decisions/Regulations. Most of the Code–Laws, and some of the Decree–Laws, are single articles giving the Government or the Minister, as the case may be, the power to issue Decree–Laws or Ministerial Decisions/Secondary Legislation dealing with the relevant matter.

Existing Legal Instruments Governing the Hydrocarbons Sector

I. **Code–Laws Passed by the Parliament**

(i) ***Code–Law #57 dated May 25, 1991—The Lebanon-Syria Treaty***

The Lebanon-Syria Treaty is a general treaty that covers political, economic, and cultural relations between Lebanon and Syria. The actual treaty was signed by the Presidents of the two countries on May 22, 1991, and was ratified by this Code–Law. On the economic front, the treaty covers, among other matters, trade in oil derivatives, and the supply of natural gas to Lebanon by Syria.

(ii) ***Code–Law #228 dated May 31, 2000—The General Privatization Law***

This Code–Law defines the forms and manner of private sector involvement in the privatization of state-owned assets in key sectors of the economy, such as the energy sector. The Code–Law also requires that each privatization, and private sector involvement in a key sector designated as such, must receive prior approval of the Parliament.

(iii) ***Code–Law #247 dated August 7, 2000—Merging, Abolition, and Creation of Ministries and Counsels***

This Code–Law, created the Ministry of Energy and Water (MEW), abolished the Ministry of Oil, and merged the Directorate of Oil into MEW. Mention of the Ministry of Oil will be replaced in all Laws, Decree–Laws, and Regulations by MEW.

(iv) ***Code–Law #462 dated September 2, 2002—The Electricity Law***
This Code–Law defines, among other things, the roles of the Government, the entities in the sector, and that of the private sector, the structure of the sector, and the principles of private sector involvement, and creates an independent regulatory agency and the principles of regulation.

(v) ***Code–Law #549 dated October 22, 2003—The Law on Designing, Financing, Development, Rehabilitation, and Operation of Tripoli and Zahrani Refineries; Construction of a Terminal for the Export and Import of liquefied natural gas (LNG); Construction of Facilities to Store Natural Gas; and Establishment of Networks to Sell and Distribute Natural Gas***
This Code–Law allows the Government to tender for and contract on a DBOT (Design, Build, Operate, and Transfer) basis; the designing, financing, development, rehabilitation, and operation of Tripoli and Zahrani Refineries; the construction of a terminal for the export and import of LNG; the construction of facilities to store natural gas; and establishment of a networks to sell and distribute natural gas. This Code–Law does not address technical and economic regulation of these facilities.

II. DECREE–LAWS ISSUED BY THE GOVERNMENT

(vi) ***Decree–Law #10095 dated April 11, 1975 & Ratification Decree #10537 dated July 31, 1975***
Decree–Law #10095 gives the Ministry of Industry and Oil (now the MEW) the right to reconsider and revise all licenses and monopoly rights given for exploration and production of hydrocarbons in Lebanese territory with the right to cancel the licenses and monopoly, and to enter into agreements with new specialized companies for exploration and production of hydrocarbons. Under the Ratification Decree–Law #10537, the Lebanese Company for Exploration of Oil and Gas has sole monopoly and was the only company licensed for oil and gas exploration.

(vii) ***Decree–Law #79 dated June 27, 1997—Fixing the Financial, Economic, and Administrative Rules for Oil Refineries in the Lebanese Territory***
This Decree–Law gives the Ministry the authority to administer and run oil refineries on the Lebanese territory in accordance with market and commercial rules.

(viii) ***Decree–Law #121 dated June 30, 1977—The Creation of a Joint-Stock Company to Transport Oil with Pipelines from Tripoli and Zahrani***
The Decree–Law created a public-private Joint-Stock Company under the name "The Lebanese Pipeline Company" with an initial capitalization of 30 million Lebanese Pounds to construct, own, and operate an oil transmission pipeline connecting the two oil terminals in Tripoli and Zahrani.

(ix) ***Decree–Law #4430 dated December 03, 1993—Abolition of the Monopoly License for Oil and Gas Exploration***
This Decree–Law cancelled the monopoly license of the Lebanese Company for Oil and Gas Exploration provided under Decree #10537 dated July 31, 1975. This Decree–Law enabled the MEW, in August 2002, to enter into agreement with Spectrum Energy and Information Technology of the United Kingdom to prepare the necessary documentation for international bidding-round for offer of licenses to interested international oil companies for offshore drilling and exploration for hydrocarbons, based on the results of seismic surveys conducted by Spectrum in the offshore territorial waters and economic zone of Lebanon.

(x) ***Decree–Law #5039 dated April 9, 1994—Rules for Entering into Contractual Arrangements with Companies for Oil and Gas Exploration***
The Decree–Law states the rules governing entering into agreement with companies for exploration of oil and gas. It states the following:

- *Nature of the agreement*: public-private partnership

- *Territory/concession area*: 1000 km²;
- *Duration of concession*: maximum 30 years; and
- *Profit sharing.*

(a) For oil—

- 65 percent state/public, 35 percent private company for production less than 25,000 barrels/day.
- 70 percent state/public, 30 percent company for production between 25,000 and 50,000 barrels/day.
- 75 percent state/public, 25 percent private company for production between 50,000 and 75,000 barrels/day.
- 80 percent state/public, 20 percent private company for production more than 75,000 barrels/day

(b) For gas—

- 60 percent state/public, and 40 percent private company.

The Decree–Law further clarifies that all the initial capital investments will be made by the private sector, and the investments will be recovered by the private sector over time through yearly compensation of 45 percent of the value of the yearly oil produced, and 50 percent in the case of natural gas. In case of no oil or natural gas production, the private sector will assume all the loss without any form of compensation from the Government of Lebanon.

(xi) ***Decree–Law #5509 dated August 11, 1994—Organization and General Rules for Storage Places of Oil Products, Cisterns, and Gasoline Stations***

This Decree–Law gives the Ministry of the Industry and Oil the exclusivity in fixing the rules for implementing and organizing of the following:

- Storage places of oil products;
- Tank trucking; and
- Gasoline stations.

(xii) ***Decree–Law #5484 dated May 18, 2001—Protocol between Lebanon, Syria, Egypt, and Jordan on Exports and Marketing of Natural Gas***

This Decree–Law ratified the protocol of understanding between Lebanon-Syria-Egypt and Jordan for export of natural gas from Egypt and Syria to Lebanon and Jordan through two pipelines, one terrestrial and the other offshore. It also calls for the creation of two companies for the construction and operations of the pipelines: the offshore pipeline company under the name of **"Ahchark Company,"** and the terrestrial pipeline company under the name of **"Arabia Company."** The Decree also states the rules for setting up the companies will be defined by the High Committee, which includes the energy ministers of the participating countries.

III. Ministerial Decisions/Secondary Legislation

(xiii) ***Minister Decision #56 dated July 25, 1997—Specifications of Oil Derivatives***

By this Decision, the Minister of Oil (now the MEW) defines the technical specifications of the petroleum products imported and consumed in Lebanon. There is no petroleum law, and this decision provides a basis of technical regulation. The products concerned are as follows:

- Liquefied Petroleum Gases Commercial Propane
- Liquefied Petroleum Gases Domestic Butane/Propane mixture
- Automotive Fuel-Gasoline 92 Octane

- Automotive Fuel-Gasoline 98 Octane
- Characteristics Of Unleaded Gasoline 95 Ron
- White Kerosene (Domestic)
- Aviation Turbine Fuel
- Diesel Oil
- Automotive Fuel Diesel Oil
- Residual Fuel Oil
- Asphalt Cement Grade 40–50
- Asphalt Cement Grade 60–70
- Asphalt Cement Grade 80–100
- Liquefied Petroleum Gases Industrial Butane/Propane Mixture

Draft Laws Pending Parliamentary Approval

There are no other draft laws pending Parliamentary approval relating to downstream gas. The MEW is planning to develop a Code–Law that will address upstream oil and gas development. However, no draft of this law exists at this time.

Conclusions Regarding Existing Code–Laws, Decree–Laws, and Ministerial Decisions/Secondary Legislation

The existing Code–Laws, Decree–Laws, and Ministerial Decisions/Secondary Legislation do not appear to address downstream gas matters in any direct manner. Code–Law #549 only contemplates a DBOT contract for the design, building, construction, and operation of certain network facilities, but it does not address economic and technical regulation of downstream gas. Accordingly, a new downstream gas law will need to be approved as a Code–Law by the Parliament.

Annex 7: Model Gas Law

Model Law Regarding
the Lebanon Downstream Gas Sector

Chapter I
General Provisions

1. ***Definitions***

In this Law on Natural Gas:

(a) "*Affiliated*" means the relationship that exists between two individuals or organizations where one of them controls, or is controlled by, or is controlled by an entity which controls, the other person, where "control" means the ownership directly or indirectly of 50 percent or more of the voting rights in a company, partnership or legal entity.

(b) "*Consumer*" means a person who consumes gas for industrial, commercial, or residential purposes, and who may secure (and contract for) a Supply from a Pipeline Enterprise or any other source at its disposal as provided for in this Law on Natural Gas.

(c) "*Delivery Point*" means the point on a Pipeline System where a user of that system nominates to have gas delivered.

(d) "*Distribution*" means the activity of receiving and delivering Specification Gas through an interconnected system of gas pipelines that—

(i) has an operating pressure of less than [15] bar,

(ii) is controlled and operated as a single integrated system, and

(iii) is designed and operated solely to provide gas to consumers through pipelines [in a geographic zone to be determined from time to time by the Minister],

and may include the operation of connected Storage facilities.

(e) "*Gas*" includes natural gas, propane-air mixture, [and regasified liquefied natural gas (LNG)].

(f) "*Gas Sector*" means the activities of [LNG Import,] Transmission, Distribution, Shipping, Storage, and Supply.

(g) "*License*" means a grant of rights and obligations for [LNG Import,] Transmission, Distribution, Shipping, or Supply issued in accordance with this Law on Natural Gas.

(h) ["*LNG*" means liquefied natural gas.]

(i) ["*LNG Import*" means the process of importing LNG into Lebanon and regasifying it for delivery in a Pipeline System.]

(j) ["*LNG Enterprise*" means any individual or organization who carries out the function of LNG Import in a LNG System.]

(k) ["*LNG System*" includes all facilities owned by a LNG Enterprise required to carry out the functions of LNG Import.]

(l) "*LPG*" [liquefied petroleum gas] means propane, propylene, butane, and butylene, and small amounts of other constituents of natural gas that have been compressed and stored in high-pressure cylinders.

(m) "*Minister*" means the Minister of Energy and Water (MEW).

(n) "*Ministry*" means the Ministry of Energy and Water (MEW).

(o) "*Pipeline*" means a line that is used or is to be used for the transmission or distribution of gas.

(p) "*Pipeline Enterprise*" means any individual or organization who carries out the functions of Transmission or Distribution on a Pipeline System.

(q) "*Pipeline System*" means a pipeline and all branches, extensions, Storage facilities, compressors, loading facilities, interstation systems of communication by telephone or radio, and real and personal property and works connected therewith that are owned by a Pipeline Enterprise and are required to carry out the functions of Transmission or Distribution.

(r) "*Propane-Air-Mixture*" means LPG that has been regasified and is distributed on a Pipeline System.

(s) "*Public Service Obligations*" means the obligations that the Minister or the Regulator is empowered to impose on Suppliers and Pipeline Enterprises to supply gas to consumers in accordance with this Law on Natural Gas.

(t) "*Receipt Point*" means the point on a Pipeline System where a user of that system nominates to present gas for transportation.

(u) "*Regulator*" has the meaning given in Article 9.

(v) "*Ship*" or "*Shipping*" means the introduction, conveyance, and removal of gas from a Pipeline System.

(w) "*Shipper*" means any person who arranges with a Pipeline Enterprise for the Shipping of gas, and may be an importer, supplier, producer, or consumer of gas, but does not include a person who does not take physical title to or possession of gas.

(x) "*Specification Gas*" means gas that meets the Receipt Point quality specifications provided by a Pipeline Enterprise and that is approved by the Regulator in the relevant license.

(y) "*Standard License Conditions*" means the common set of conditions established by the Regulator and approved by the Minister in accordance with this Law on Natural Gas that

specify the rights and obligations of the holders of each type of license that may be granted under this Law on Natural Gas.

(z) "*Storage*" means the activity of receiving, holding, and delivering gas at underground facilities in geological formations.

(aa) "*Supplier*" means any person who provides a Supply to a Consumer, other than a Pipeline Enterprise supplying gas to a consumer on its Pipeline System.

(bb) "*Supply*" means the sale or commercial provision of gas by pipeline by either a Pipeline Enterprise or a Supplier to any electricity generator, industrial or commercial concern, residential, or other gas user, for consumption by that user.

(cc) "*Tariff*" means the price charged by the following entities:

(i) a Pipeline Enterprise for providing transportation services to a Shipper for the Transmission or Distribution of gas on its Pipeline System, and where applicable, for providing a Supply; or

(ii) a Supplier for providing a Supply,

and includes any toll, tariff, rate, charge, or allowance charged or made for the shipment, transportation, transmission, care, handling, or delivery of gas that is transmitted through a pipeline, or for storage or demurrage or the like, for the provision of a pipeline when the pipeline is available and ready to provide for the transportation of gas, and in respect of the purchase and sale of gas that is the property of any such enterprise and that is transmitted by the enterprise through its facilities, excluding the cost to the enterprise of the gas at the point where it enters the facilities.

(dd) "*Transmission*" means the activity of receiving, transmitting, and delivering Specification Gas through high pressure pipelines, which have a normal operating pressure exceeding [15] bar, from import locations, [LNG regasification facilities,] gathering facilities, or processing facilities, to the Delivery Points of connected Pipeline Systems, and includes connected treatment or Storage facilities and may include Supply to consumers connected to its Pipeline System.

2. *Scope of the Law on Natural Gas*

This Law on Natural Gas governs the transmission, distribution, shipping and supply of gas [and the import of LNG,]. This Law on Natural Gas regulates gas sector activities, determines the legal position of gas sector enterprises and consumers, and provides principles and norms in gas sector activities in the Republic of Lebanon.

3. *Purposes of the Law on Natural Gas*

The objectives of this Law on Natural Gas are as follows:

(a) Promote competitiveness of markets for the supply (whether from domestic sources, imports of pipeline gas, or LNG) and demand for gas, and to encourage investments to secure long-term supply;

(b) Promote better operation, reliability and fairness, open access, nondiscrimination, and extended use of [LNG Import and] natural gas transmission, distribution, and supply, including related facilities and services;

(c) Regulate the activities of [LNG Import and] natural gas transmission, distribution, shipping, and supply, and to ensure that tariffs are fair and reasonable in accordance with the provisions of this Law on Natural Gas;

(d) Establish a Regulator [under the authority of the Ministry] to regulate safety, technical, and economic aspects of the gas sector, responsible for applying regulatory principles of equality, openness, accountability, transparency, and nondiscrimination;

(e) Stimulate efficiency in the transmission, storage (where suitable), distribution, shipping, supply, and use of gas [, and in the import of LNG];

(f) Encourage the use of natural gas as a fuel for electricity generation, for industries and in commercial and residential areas; safeguard the environment; and support the climate change initiative;

(g) Develop a competitive market for gas through the creation of a market structure that encourages private sector investment, ownership, operation, and management control of entities in the gas sector;

(h) Ensure the supply of gas at efficient prices and appropriate standards of quality and safety to meet consumers' requirements to improve the efficiency of the economy and increase the welfare of all Lebanese citizens; and

(i) Establish a licensing regime for the transmission, distribution, shipping, and supply of gas by means of pipeline systems [and for the import of LNG].

4. ***Environment Protection in the Gas Sector***

All gas sector activities shall conform to regulations stipulated in laws on environment protection [*specify the currently applicable laws as follows: "including, without limitation, . . ."*].

5. ***International Cooperation in Gas Activities***

(a) The Government promotes international cooperation in gas sector activities with countries, international organizations, foreign institutions, and individuals on the basis of respect for independence, sovereignty, and mutual benefit.

(b) The Government encourages, facilitates, and provides favorable conditions for domestic organizations and individuals to cooperate with foreign individuals, organizations, and international organizations engaging in gas sector activities.

Chapter II
Gas Sector Strategy

6. ***Gas Market Structure***

The gas market structure in Lebanon initially shall involve imports of gas from Syria by a single gas supplier to a single gas buyer, and for the purpose of displacement of oil as a fuel for power generation. However, all licenses issued under this Law on Natural Gas initially, or at a future time, shall contemplate the following attributes:

(a) Competitive activities in relation to gas supply and shipping shall be separate from the natural monopoly transmission and distribution activities of Pipeline Systems.

(b) Transportation contracts shall be separate from commodity contracts for import and supply of gas.

(c) All Consumers and Suppliers shall have open access to Pipeline Systems.

(d) Gas supply to Lebanon will be for the purposes of a fuel for power generation, industrial, commercial, and residential use. Consumers in all categories eventually shall be able to choose their source of gas supply by contract with a Supplier or the Pipeline Enterprise, which delivers gas to the consumer on its Pipeline System. Consumers are free to negotiate the commodity price for their Supply from a Supplier. Transportation prices on the Pipeline System are regulated.

7. ***Gas Imports***

Until competition has developed, no person may import gas into Lebanon without prior approval by the Regulator [the Minister]. When assessing whether to approve gas imports, the Regulator [the Minister] will determine whether the reasonably foreseeable needs of Lebanese citizens for gas would merit the import of gas and whether the import of gas is on an economic purchase basis.

8. ***Land Use for Gas Facilities***

(a) Developers of gas sector facilities that involve land use shall establish a plan and timetable for compensation in accordance with law to be submitted to [the Ministry/the Regulator] for approval. [The Ministry/the Regulator] may publish [decrees taken in the council of ministers/directions] establishing the principles of compensation that it intends to apply when assessing land use compensation plans.

(b) [The Ministry/the Regulator] shall be responsible for timely ensuring that individuals and organizations involved in gas sector activities have the rights of land use in accordance with law to construct and install gas sector facilities and projects.

(c) When gas sector projects and technical design have been approved by [the Ministry/the Regulator], project investors shall have the right to construct and install gas equipment and facilities on or under areas used by other individuals and organizations in compliance with approved designs and requirements regarding safety corridors.

(d) Upon having designated the right to use land, developers of gas sector facilities shall pay compensation for the use of land and property in accordance with the directions of the Regulator [and/or decrees issued by the Minister].

[*The provisions of this section need to be coordinated with any existing Lebanese law relating to land use compensation in an expropriation, surface lease, or right-of-way situation.*]

Chapter III
Regulator

9. ***Establishment of Regulator.*** The [*insert name of Regulator*] (the "Regulator") is established by this Law on Natural Gas as the competent regulatory commission under the Ministry to regulate gas sector activities as described in this Law on Natural Gas. In performing its activities under this Law on Natural Gas, the Regulator shall have regard to the provisions of this Law, except where it conflicts with provisions governing the regulator established under the Law on Electricity Sector Organization (Law #462 issued on 05/09/2002). [*NOTE: If a Regulator is merged with the Regulator established under the Law on Electricity Sector Organization, then some of sections 11 to 24 may not be necessary to the extent that similar rules appear in the Law on Electricity Sector Organization, and those rules would apply to the Regulator.*]

10. ***Effective Date.*** The Regulator shall be formed and be entitled to exercise its powers on the date specified by the Ministry.

11. ***Conduct.*** Members and staff of the Regulator shall not engage in other employment, and shall perform their duties faithfully, impartially, honestly, and according to law. They may not take advantage of their positions to seek illegitimate gains.

12. ***Confidentiality.*** When the Regulator and its members and staff perform their lawful functions, they shall be obligated to maintain the confidentiality of a person's or enterprise's commercial secrets of which they become aware where the Regulator is satisfied that—

(a) Disclosure of the information could reasonably be expected to result in a material loss or gain to a person or enterprise directly affected by the functions of the Regulator, or reasonably could be expected to prejudice the person's or enterprise's competitive position; or

(b) The financial, commercial, scientific, or technical information is confidential information supplied to the Regulator and the information has been consistently treated as confidential information by a person or enterprise directly affected by the functions of the Regulator, and the Regulator considers that the person's or enterprise's interest in confidentiality outweighs the public interest in disclosure.

13. ***Functions of Regulator.*** The Regulator shall perform the following functions in regulating the gas sector:

(a) To regulate—through the issuance, monitoring, modification, and enforcement of licenses and the issuance of decisions, orders, and directions under this Law on Natural Gas—the construction and operation of [LNG Systems,] Pipeline Systems, Shipping, and Supply in accordance with and subject to the provisions of this Law on Natural Gas;

(b) To ensure proper qualification of [LNG Enterprises,] Pipeline Enterprises, Shippers, and Suppliers, including without limitation, ensuring that such enterprises are commercially viable, credit-worthy persons with the technical capability to perform their obligations;

(c) To monitor developments in the import, export, transmission, distribution, storage, shipping, and supply of gas in Lebanon;

(d) To implement and ensure compliance by the relevant persons with any license, rule, decree, decision, order, or direction issued in accordance with this Law on Natural Gas;

(e) To study and keep under review matters relating to the import, export, transmission, distribution, storage, shipping, and gas supply industry, which the Ministry requests the Regulator to monitor, and report from time to time on such matters and recommend such measures as it considers necessary or advisable in the public interest for the control and development of that industry; and

(f) To deal with regulators or government ministries and departments responsible for regulation in adjacent countries regarding cross-border pipelines.

The Ministry may confer on the Regulator such additional functions in relation to the regulation, monitoring, and control of [LNG Import,] Transmission, Distribution, Shipping, and Supply and associated matters connected with the functions for the time being of the Regulator as are appropriate, and may make such provisions (including the provision of additional powers) as are necessary or expedient in relation to matters ancillary to or arising from the conferral on the Regulator of additional functions under this Article.

14. ***Immunity***. [No action or other proceedings may be taken against the Regulator or its members or staff arising from a failure to perform or to comply with any of the functions conferred on the Regulator.] [*Consider whether this is suitable in light of applicable administrative law in Lebanon.*]

15. ***Powers of Regulator***. When performing its functions according to law, the Regulator shall have the following powers:

(a) To grant licenses authorizing the Transmission, Distribution, Shipping, and, where appropriate, [LNG Import and] Supply of gas in accordance with Article 27, or to grant exemptions in accordance with Article 37;

(b) To modify and revoke licenses authorizing the Transmission, Distribution, Shipping, and, where appropriate, [LNG Import and] Supply of gas in accordance with Article 35;

(c) To make directions and enforce directions and decrees taken in the council of ministers to ensure compliance with licenses authorizing the Transmission, Distribution, Shipping, and, where appropriate, [LNG Import and] Supply of gas;

(d) To inquire into, hear, and determine any matter where it appears to the Regulator that any person has failed to do any act, matter, or thing required to be done by this Law on Natural Gas or any rule, license, decision, decree, order, or direction issued pursuant thereto, or that any person has done or is doing any act, matter, or thing contrary to or in contravention of this Law on Natural Gas, or any such rule, license, decision, decree, order, or direction issued pursuant thereto;

(e) To order and require any person to do at any specified time and in any manner prescribed by the Regulator, any act, matter, or thing that such person is or may be required to do under this Law on Natural Gas, or any rule, license, decision, decree, order, or direction issued pursuant thereto and to forbid the doing or continuing of any act, matter, or thing that is contrary to this Law on Natural Gas or any such rule, license, decision, decree, order, or direction pursuant thereto;

(f) In connection with the foregoing, to gather information, including compelling the provision of information from any license holder;

(g) To assess penalties for the breach of any rule, license, decision, decree, order, or direction issued pursuant to this Law on Natural Gas, in accordance with Chapter V;

(h) To work cooperatively with foreign regulators, ministries, or departments responsible for regulation in adjacent countries regarding cross-border pipelines;

(i) To make rules in accordance with Article 18 and Article 19; and

(j) Of its own motion, to inquire into, hear, and determine any other matter or thing that under this Law on Natural Gas it may inquire into, hear, and determine.

16. ***Investigation of Complaints***. It shall be the duty of the Regulator to investigate or cause to be investigated whether any relevant requirement or condition of a license has been or is being contravened either where such a contravention is the subject of a representation made to the Regulator or where the Regulator is of the opinion that there may be such a contravention, where such purported contravention relates to a license issued under this Law on Natural Gas or is otherwise within the authority of the Regulator.

17. ***Disclosure***. When the Regulator and its members and staff perform their lawful functions, persons and enterprises under inspection or investigation shall cooperate and provide truthful and relevant documents and materials. Such persons and enterprises may not refuse to cooperate, obstruct inspection or investigation, or conceal relevant documents or materials.

18. ***Rules***. The Regulator may, following consultation with the Ministry, make such rules as appears to it requisite or expedient having regard to its duties and functions, including rules requiring or prohibiting certain commercial conduct of gas industry participants so as to ensure the orderly functioning of the gas sector, including the following:

(a) The use of meters to record quantities of gas supplied;

(b) The installation, inspection, and maintenance of meters and service pipes;

(c) Grounds for and procedures for connection and disconnection of consumers;

(d) Misuse and theft of gas;

(e) Procedures for dealing with gas escapes; and

(f) The powers to enter private property.

The Regulator may only make such rules after consulting with license holders and with persons or bodies appearing to it to be representative of persons likely to be affected by the rules. Rules made pursuant to this Article may not have the effect of amending or materially altering the provisions or conditions of any license. Amendments and material alterations to licenses may only occur pursuant to Article 35.

19. ***Procedural Rules***. The Regulator may make rules respecting the sittings of the Regulator; the procedure for making applications, representations, and complaints to the Regulator; the conduct of hearings before the Regulator; and the manner of conducting any business before the Regulator; and, generally, the carrying on of the work of the Regulator, the management of its internal affairs, and the duties of its staff. When making these rules, the Regulator shall seek to incorporate principles of openness, transparency, accountability, and independence.

20. ***Annual Report***. As soon as may be practicable after the end of year, but not later than six months thereafter, the Regulator shall cause a report on the performance of its functions during that year to be provided to the Ministry.

21. ***Documents***. The Regulator shall make available to the public:

(a) The rules established by the Regulator pursuant to Article 18 and Article 19;

(b) Decisions, orders, and directions of the Regulator;

(c) Decrees taken in the council of ministries if not otherwise publicly available;

(d) Penalties imposed by the Regulator;

(e) Annual reports of the Regulator contemplated by Article 20;

(f) The classes of Consumers as contemplated by Article 6;

(g) The Standard License Conditions; and

(h) The licenses issued by the Regulator.

The Chairman or other staff member of the Regulator designated by the Chairman shall be responsible for maintaining the documents, files, and records of the Regulator.

22. ***Relationship of Ministry and Regulator***. The Ministry may provide general policy guidance to the Regulator in connection with the performance of the Regulator's functions under this Law on Natural Gas. Policy guidance provided by the Ministry shall be published by the Ministry in the same manner as other legislative and policy matters are published. When performing its duties under this Law on Natural Gas, the Regulator shall take into account the policy directives issued by the Ministry. The Ministry does not have the right or power to intervene in any specific issue or matter that may be brought before the Regulator.

23. ***Appeal***. Except as provided in this Article, every decision, order, or direction of the Regulator is final and conclusive. An appeal may be made to [Ministry][administrative court] from a decision, order, or direction of the Regulator on a question of law, or of jurisdiction, or bias on the part of a member of the Regulator who participated in the decision, order, or direction, or of compliance with the rules of procedural fairness described in Article 24. No appeal lies from a decision of the Regulator on any other

grounds. An application for appeal must be made within 30 days after the release of the decision, order, or direction sought to be appealed.

24. ***Procedural Fairness***. In performing its functions under this Law on Natural Gas, the Regulator shall do the following:

(a) Give notice to interested persons of any application received or hearing that the Regulator is to conduct in the manner provided in this Law on Natural Gas;

(b) Conduct hearings with respect to the issuance, revocation, or suspension of licenses in those circumstances provided for in this Law on Natural Gas;

(c) Give written reasons for its decisions, orders, and directions, which reasons shall be given at the time of the decision, order, or direction; and

(d) Where a decision, order, or direction is made after a hearing, render its decisions based on the evidence, argument, and information presented at the hearing.

25. ***Levies***. Subject to the approval of the Ministry, the Regulator may, for the purposes of recovering all or a portion of such costs as the Regulator determines to be attributable to its responsibilities under this Law on Natural Gas, impose fees, levies, or charges on any enterprise that holds a license issued pursuant to this Law, and provide for the manner of calculating the fees, levies, and charges in respect of the person or company and their payment to the [Ministry of Finance] [Government of Lebanon]. The Regulator may also specify the rate of interest or the manner of calculating the rate of interest payable by an enterprise on any fee, levy, or charge not paid by the person or company on or before the date it is due.

Chapter IV
Licenses

26. ***Prohibition of Unlicensed Activities***. No person may—

(a) Construct or operate a Pipeline System [or LNG System]; or

(b) Carry on [LNG Import,] Transmission, Distribution, Shipping, or Supply,

unless authorized to do so by a license or exemption given under this Law on Natural Gas.

27. ***Issuance of Licenses***

Upon application by an applicant, the Regulator may issue a license authorizing the following:

(a) The construction and operation of a Pipeline System by a Pipeline Enterprise for the Transmission or Distribution of gas;

(b) [The construction and operation of a LNG System and LNG Import by a LNG Enterprise;]

(c) The Shipping of gas by a Shipper; or

(d) The Supply by a Supplier.

A separate license is required for each connected system of gas pipelines for the Distribution or Transmission of gas. A license for Supply by a Supplier or the operation of a Pipeline System by a Pipeline Enterprise may include a requirement to comply with Public Service Obligations. A Pipeline Enterprise is not required to hold a Supply license for Supply to any consumers connected to its Pipeline System where its license establishes the terms governing Supply to such consumers.

28. ***License Conditions regarding Access and Tariffs***

The Standard License Conditions for licenses issued under this Chapter IV shall include the following requirements:

(a) An enforceable legal right of third parties to gain access on a fair and equal basis to existing, new, and expanded Pipeline Systems, with the details of such access to be determined by the Regulator.

(b) A requirement that the Tariffs for the transportation of gas between Pipeline Enterprises and their respective users be established, reviewed, and revised by the Regulator, provided that such Tariffs take into account the following principles:

(i) Be cost-reflective so that the costs of transmission and/or distribution assets and their operation are allocated to users according to costs imposed by their use of these assets, and Pipeline Enterprises should have the opportunity to earn an economic rate of return on the pipeline investment;

(ii) [Reflect transport distance, so that Tariffs may be zonal, entry/exit or postage stamp–based, or a combination of these;] and

(iii) [Include guaranteed (firm) capacity and interruptible service components.]

(c) Where the license involves Supply, the following principles apply:

(i) A requirement that Tariffs for Supply applied to Consumers who have not negotiated their Supply Tariffs be established, reviewed, and revised by the Regulator, provided that such Tariffs take into account the following principles:

(1) The price of gas, as approved by the relevant Government authority (who may be the Minister or the Regulator), which should be competitive with prices for alternative fuels; and

(2) The constituent cost elements involved in providing the Supply to the Consumer, comprising the transmission tariff, the distribution tariff (as applicable), the price of gas, and other reasonable supply-related costs.

(d) requirements that:

(i) An issue of compliance with the principles in Article 28 shall be decided by the Regulator; and

(ii) The Regulator may issue a direction on the interpretation of the principles in Article 28.

29. ***Code of Conduct for Certain License Holders***

(a) If a Pipeline Enterprise wishes to transport gas on its own Pipeline System, it shall apply in its license for the right to do so, and the Regulator may issue such license, provided that the Regulator shall include provisions in the license requiring such enterprise to establish separate accounts for its Transmission, Distribution, Shipping, and Supply activities and other activities, and to establish a code of conduct governing the appropriate behavior of such enterprise in its dealings with other users of the Pipeline System.

(b) Where an individual or organization who has a contract for the transportation of gas on a Pipeline System is affiliated with the enterprise holding the license for such facilities, then the Regulator may include provisions in the license of the Pipeline Enterprise that establish a code of conduct governing the appropriate behavior between the affiliates in relation to licensed activities, including separate accounts.

(c) If a Pipeline Enterprise is the Supplier of gas to Consumers connected to its Pipeline System, it must establish and maintain a code of conduct approved by the Regulator governing the appropriate behavior between its Pipeline System and Supply businesses in relation to licensed activities, including separate accounts.

30. ***Evaluation of Applications***

(a) An application for a license shall be made in the manner prescribed by the Regulator and shall be accompanied by such application fee (if any) as may be prescribed by the Regulator.

(b) Subject to the conditions of this Article, the Regulator shall evaluate each application for a license. Before granting any license, the Regulator shall give notice to all potentially interested persons stating that it intends to consider the license application and specifying the period (not being less than • days from the date of publication of the notice) within which representations or objections with respect to the application may be made. The Regulator shall consider any representations or objections which are duly made and not withdrawn.

(c) The Regulator may notify the applicant that, on the basis of its findings and any public input received, it intends to issue the license or reject the license. Notice of the findings and reasons for those findings and the decision shall be served on the applicant concerned and any parties who provided input to the Regulator within [three] months of the latter of the application and any hearing, and such findings and decision shall be made available by the Regulator on request. If the findings of the public consultation and the decision results in a material variation in the application made to the Regulator by the applicant for the license, then the applicant has the right of accepting or rejecting the license that results from the application.

31. ***License Term***

A license shall be in writing and, unless previously revoked in accordance with any term contained in the license, shall continue in force for such period as may be specified in or

determined by or under the license. The Standard License Conditions may contemplate the periodic review of any Tariff established in the license.

32. ***Form of License***

The Standard License Conditions for licenses related to [LNG Import,] Transmission, Distribution, Shipping, or Supply shall be established by the Regulator and approved by the Minister. The form of a particular license for [LNG Import,] Transmission, Distribution, Shipping, or Supply shall be determined by the Regulator based on the circumstances of the particular application.

33. ***Public Consultation***

(a) To involve stakeholders and provide transparency in the decisionmaking, this Law on Natural Gas contemplates the Regulator seeking public consultation in specified circumstances. The Regulator shall give notice stating the date (being not less than 30 days from the date of giving notice) by which consultation is sought and the manner in which it may be provided.

(b) All consultations shall be open to members of the public, and may be held before a quorum of members of the Regulator or any other individual or organization authorized by the Regulator to hold such a hearing.

(c) At a public consultation, those individuals or organizations by whom objections or representations were made shall be permitted to be heard.

(d) The Regulator may administer oaths; issue notices in the name of the Regulator; issue subpoenas; compel the attendance of witnesses and the production of books, accounts, papers, records, documents, and material in any media; and take and receive evidence.

(e) The Regulator shall, within a reasonable time from the date of completion of a public consultation, prepare its findings on the basis of such consultation.

34. ***Compensation***

The Regulator may fix such amount as it deems reasonable in respect of the actual costs reasonably incurred by any individual or organization who made representations to the Regulator at a public consultation and the amount so fixed shall be payable forthwith to that individual or organization by the applicant or license holder affected by the public consultation.

35. ***Modification and Revocation of Licenses***

(a) Subject to the conditions of this Article, the Regulator may modify the conditions of a license or revoke a license.

(b) A license may be modified by the Regulator if (i) a policy decision of the Minister would require modification to any license; or (ii) any other circumstances exist or arise where the Regulator considers such modification to be necessary or desirable.

(c) A license may be revoked by the Regulator if (i) the license holder requests its revocation, and the Regulator considers such revocation to be appropriate; or (ii) the

conduct of the license holder leads the Regulator to conclude that enforcement of the penalty provisions set forth in Chapter V would be insufficient to sanction such conduct, and revocation of the license is justifiable based on repeated noncompliance by the license holder with its obligations under the license. An application to modify or revoke a license may be made by the Regulator on its own accord, or upon the request of a license holder or an interested party.

(d) Before modifying or revoking any license, the Regulator shall give notice of the application to modify or revoke the license and set out its potential effect, stating the reasons for the proposed modifications or revocation and specifying the period (not being less than • days from the date of publication of the notice) within which representations or objections with respect to the proposed modifications or revocation may be made. In all other respects, the process to be followed by the Regulator in the modification or revocation of a license shall be the same as the process for the evaluation of an application for a license pursuant to Article 30.

36. ***Breach of License***

The Regulator, on being satisfied that a license holder is contravening or is proposing to contravene any relevant condition of a license granted by it under this Law on Natural Gas, and where the Regulator is satisfied that immediate action is necessary to protect public health, safety, or the environment or to prevent the dissipation of the assets of a license holder, may direct the license holder engaging in or proposing to engage in such practices to discontinue or refrain from such practices.

37. ***Exemptions***

(a) The Minister may specify individuals or organizations of a particular class to whom exemptions from the requirement to hold a license for [LNG Import,] Transmission, Distribution, Shipping, or Supply may be granted by the Regulator. [The Minister may only specify the following classes of individuals or organizations to whom exemptions may be granted:]

(i) Gas transporters whose Transmission Pipeline Systems are less than • kilometres; and

(ii) [*Insert here any other categories of activities where exemptions may be appropriate*].

(b) The Regulator may grant an exemption from the requirement to hold a license for [or LNG Import,] Transmission, Distribution, Shipping, or Supply by those classes of individuals or organizations or a particular individual or organization covered by the categories listed in such an exemption. An exemption granted by the Regulator may be revoked in accordance with any term contained in the exemption.

(c) Where the Minister revises the classes of individuals or organizations to whom an exemption may be granted and the effect of this amendment is to require individuals or organizations previously exempt to hold licenses, then an exemption granted to such individuals or organizations is revoked.

38. ***Transfer***

A transfer of a license or any interest in a license is not effective until authorized by the Regulator [and approved by the Minister].

39. ***Inspection by Regulator***

The Regulator shall be responsible for conducting regular inspections of performance by any license holder of the following:

(a) Decisions, orders, and directions of the Regulator;

(b) Decrees taken in the council of ministers;

(c) Terms and conditions of the license; and

(d) The requirements of this Law on Natural Gas.

Chapter V
Legal Liability

40. [*Penalties—to be completed by the Government of Lebanon.*]

Chapter VI
Supplementary Provisions

41. ***Regulator as Arbitrator***

The Regulator shall act as binding arbitrator of any disputes involving a license holder where—

(a) Such dispute arises pursuant to or in relation to a license, including without limitation:

(i) Disputes regarding access to spare capacity;

(ii) Tariffs; or

(iii) [*Others*]; or

(b) Such dispute arises pursuant to a contract between any license holder and a third party, and such contract specifies that the Regulator is the arbitrator in a binding arbitration contemplated under the contract.

42. ***Other Transitional Matters***

All provisions of prior laws, regulations, and decrees that are inconsistent or in conflict with the provisions of the present Law become null and void upon coming into force of this Law.

[*Other transitional and miscellaneous matters—to be completed by the Government of Lebanon.*]

Annex 8: Detailed Calculation of Environmental Benefits from Switching to Gas

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Generation (GWh)	11,773	12,212	12,513	12,799	13,103	13,367	13,674	13,913	14,089	14,222	14,356	14,490	14,828	15,165	15,485	15,811	16,151	16,488	16,838	
Case 1 (no natural gas)																				
PM (tons/yr)	1,900	2,034	2,122	2,192	2,248	2,293	2,035	2,058	2,074	2,086	2,098	2,109	2,137	2,162	2,184	2,205	2,125	2,148	2,171	
SO_x (tons/yr)	26,343	28,290	29,647	30,817	31,807	32,631	31,122	31,520	31,806	32,022	32,234	32,443	32,947	33,422	33,844	34,246	34,046	34,503	34,947	
NOx (tons/yr)	10,466	11,285	11,898	12,471	12,984	13,417	13,946	14,150	14,297	14,409	14,520	14,629	14,897	15,153	15,384	15,605	16,020	16,273	16,521	
CO_2 (tons/yr)	358,403	386,381	407,318	426,825	444,253	458,979	475,883	482,817	487,829	491,629	495,384	499,092	508,198	516,903	524,732	532,235	545,937	554,509	562,927	
Case 2 (maximum natural gas)																				
PM (tons/yr)	1,900	2,034	2,122	2,133	2,131	2,203	814	828	837	845	852	860	878	819	836	853	869	885	900.9	
SO_x (tons/yr)	26,343	28,290	29,647	27,024	24,322	25,277	9,229	9,422	9,564	9,674	9,784	9,894	10,167	9,304	9,544	9,794	10,050	10,300	10,548	
NOx (tons/yr)	10,466	11,285	11,898	11,756	11,574	12,006	10,911	11,085	11,212	11,309	11,405	11,500	11,736	11,917	12,144	12,371	12,601	12,823	13,043	
CO_2 (tons/yr)	358,403	386,381	407,318	409,895	410,846	425,861	411,937	418,414	423,115	426,688	430,228	433,731	442,360	448,811	457,189	465,571	474,018	482,147	490,153	
Difference between 1 and 2																				Total
PM (tons/yr)	0	0	0	59	117	91	1,221	1,230	1,236	1,241	1,245	1,249	1,259	1,343	1,348	1,352	1,256	1,263	1,270	16,780
SO_x (tons/yr)	0	0	0	3,793	7,486	7,354	21,892	22,098	22,242	22,348	22,450	22,549	22,780	24,118	24,300	24,452	23,995	24,203	24,399	320,458
NOx (tons/yr)	0	0	0	715	1,410	1,411	3,035	3,065	3,085	3,100	3,114	3,128	3,161	3,236	3,240	3,233	3,419	3,449	3,478	45,279
CO_2 (tons/yr)	0	0	0	16,930	33,406	33,118	63,946	64,403	64,714	64,940	65,156	65,361	65,838	68,092	67,543	66,665	71,920	72,362	72,774	957,167
Reduced Damage Costs (low externality values)																				
PM ($ million)	0	0	0	0.12	0.23	0.18	2.44	2.46	2.47	2.48	2.49	2.50	2.52	2.69	2.70	2.70	2.51	2.53	2.54	33.56
SO_x ($ million)	0	0	0	7.59	14.97	14.71	43.78	44.20	44.48	44.70	44.90	45.10	45.56	48.24	48.60	48.90	47.99	48.41	48.80	640.92
NOx ($ million)	0	0	0	1.00	1.97	1.98	4.25	4.29	4.32	4.34	4.36	4.38	4.43	4.53	4.54	4.53	4.79	4.83	4.87	63.39
CO_2 ($ million)	0	0	0	0.08	0.17	0.17	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.34	0.34	0.33	0.36	0.36	0.36	4.79
TOTAL ($ million)																				742.65
Reduced Damage Costs (high externality values)																				
PM ($ million)	0	0.00	0.00	0.29	0.58	0.45	6.10	6.15	6.18	6.20	6.23	6.25	6.30	6.72	6.74	6.76	6.28	6.32	6.35	83.90
SO_x ($ million)	0	0.00	0.00	18.96	37.43	36.77	109.46	110.49	111.21	111.74	112.25	112.74	113.90	120.59	121.50	122.26	119.98	121.01	121.99	1,602.29
NOx ($ million)	0	0.00	0.00	2.14	4.23	4.23	9.11	9.19	9.25	9.30	9.34	9.38	9.48	9.71	9.72	9.70	10.26	10.35	10.43	135.84
CO_2 ($ million)	0	0.00	0.00	0.34	0.67	0.66	1.28	1.29	1.29	1.30	1.30	1.31	1.32	1.36	1.35	1.33	1.44	1.45	1.46	19.14
TOTAL ($ million)																				1,841.17

Note: GWh = Gigawatts/hour; PM = particulate matter; SOx = Sulfur Oxides; NOx = Nitrogen Oxides; CO_2 = Carbon Dioxide; $ = US$.

Source: CEPCO 2004.)