Electric Energy & Energy Policy in Lebanon

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Abbreviations

CDR	Council for development and reconstruction
DBOT	Design, build, operate and transfer
EDL	Electricity of Lebanon
GASYLE	Gas Syria-Lebanon project
GDP	Gross domestic product
GNESD	Global network on energy for sustainable development
GoL	Government of Lebanon
GWh	Giga-watt hour
KVA	Kilo-volt amperes
KWh	Kilo-watt hour
MEW	Ministry of energy and water
MW	Mega-watt
NG	Natural gas
RES	Renewable energies
SHWS	Solar hot water systems
VAT/TVA	Value added tax

Abstract

In line with a main objective of the Global Network on Energy for Sustainable Development (GNESD), i.e. to develop national policy papers on energy access, and the prospects of using renewable energy for sustainable development and poverty alleviation, this paper was prepared under the title: “Electric Energy & Energy Policy in Lebanon”.

Current Lebanon’s energy profiles of the electricity, oil, gas and renewable energies sectors (wind, small hydro, solar for hot water, photovoltaic and biomass) were reviewed; Lebanon’s electricity profile was analyzed based on available data regarding existing power supply and demand, comparative consumptions by different categories of household consumers, tariffs structure, and the interrelationships with the socio-economic profile namely, the population category, population growth and GDP, and indirectly as it relates to the poor households.

From the data available and the ensuing analysis, the study listed the conclusive characteristics of the Lebanese electricity sector and the main challenges it is currently facing. The study concludes that the present situation of the electric sector is suffering from combined technical, administrative and financial problems that have worsened over the years.

The Lebanese government recent realization that electricity sector reforms namely, to unbundle, regulate and restructure the sector and activate the participation of the private sector is urgently needed, led to the ratification of the Law No. 462, dated April 9, 2002 (Organization of the Electric Sector in Lebanon). In this law, the logic and requirements of a liberalized market, through the separation of policy, ownership and regulation are approached but not quite developed and may require some further amendments.

However, the Lebanese Government has not set yet a road map for the implementation of the provisions of this law. The study concludes that in spite of the important subsidy granted to low level electricity consumers in Lebanon, the electricity tariffs remain higher than those in the neighbouring countries. Recent tariff studies indicated that gradual tariffs increase for consumers is required to achieve the real marginal overall cost incurred by EDL.

The immediate priority of EDL is, among other factors, to:

a) Reduce both network technical losses and network non-technical losses, and collect all its issued bills. Even if this target is achieved, EDL revenues will remain short of its expenditures, especially with the current international fuel prices.
b) Speed up the shift to natural gas in the thermal power plants and the upgrade of operation and maintenance (O & M) of the whole network.
c) Implement solar hot water heating systems (SHWS), through incentive legislation and financial facilities. The same goes for the fluo-compact lamps
d) Address the standardisation and labelling of electrical equipment and speed up the creation of a Lebanese centre for energy conservation.

Will the energy policy proposed reforms lift the Lebanese electricity sector from its pitiful and near bankruptcy state? Here, three main parties are concerned, each has a specific role: the government, the private sector and the regulatory body. Success depends on how well each party plays its role. Success also means better availability and reliability of the electric network and lower marginal electricity cost. It also means better market attraction to investors. Success would also affect directly all categories of households, and if subsidy persists indirectly, the poor and the low income households.

1. Foreword

In line with a main objective of the Global Network on Energy for Sustainable Development (GNESD), i.e. to develop national policy papers on energy access, and the prospects of using renewable energy for sustainable development and poverty alleviation, this paper was prepared under the title: "Electric Energy & Energy Policy in Lebanon".

2. Socio-Economic Profile

Lebanon is located on the Eastern coast of the Mediterranean Sea in the Middle East. Lebanon covers an area of 10 452 km^2, and consists of a narrow coastal strip of land adjacent to the Mediterranean Sea, more than 100 km long. Its coastline is about 220 km long. The climate is Mediterranean, with the temperature in the capital Beirut ranging from 5°C in winter up to 32°C in summer.

The average annual precipitation in Lebanon is 830 mm, falling during only four to five months of the year. Some 6000 km2 lands are under irrigation, with about 90 per cent of national food production dependent on irrigation.

Lebanon has a population of about 4 millions people. Urban (> 1000 inhabitants): 82 %; Rural (< 1000 inhabitants): 18 %..The rate of population growth is decreasing; for instance, the average number of born babies (from women between the age of 15-49) has dropped from 4.2 babies/ woman in 1986 to 2.3 in 2003.

Migration of Lebanese youth due to the difficult economic conditions following the civil war, if it continues at its present rate, the population increase is expected to fall short of 1% /year. The GDP & real growth rate (Sources: Banque du Liban, Association of Lebanese Banks, Ministry of Finance):

YEAR	1995	1996	1997	1998	1999	2000	2001	2002
Nominal GDP Billion USD	10.98	13.0	14.9	16.16	16.46	16.46	16.71	17.0
Real growth rate per year %		18.3	14.4	8.7	1.8	0	1.5	1.5
Minimum Salary /Month US.D per Capita	157.0	161.0	163.7	165.8	165.8	165.8	165.8	165.8

The "Schema Directeur d'Amenagement du Territoire Libanais (SDATL) - Mai 2004, prepared by the consulting firms: DAR-IAURIF) estimates the GDP in Lebanon ~ US$ 17.3 Billion in 2002 (US$ 4200/capita). Due to the major macro-economic disorders, it is difficult to reach a credible forecast on the GDP growth till 2030. However, two scenarios are proposed:

- 2% continuous yearly growth until 2030; the GDP reaches US$ 30 Billion.
- 2% yearly growth from 2003-2007, then 3.5% yearly growth between 2008-2030; the GDP reaches US$55 Billion.

However, the year 2004 achieved a GDP growth of 5% .

The poverty profile data had been analyzed in 2002 by the "Fonds de Development Economique et Social (FDES) on account of CDR. It was found that households with children going to school (4.8 persons/ house):

- 42 % of households suffer from relative poverty fixed at (US$ 782/ month).
- 7 % of households suffer from absolute poverty fixed at (US$ 314/ month).

In spite of these results, the minimum official monthly salary in Lebanon is still held for more than a decade at US$ 200 (LL 300 000) per month plus social benefits (medical and family allocations).

3. Lebanon's General Energy Profile

3.1 The Electricity sector

Following nationalization of the main private electricity company in 1954, Electricity of Lebanon (EDL), a fully vertically integrated state owned public utility, was established in 1964, enjoyed the statutes of an industrial and commercial public institution and entrusted the monopoly of the generation, transmission and distribution functions of the electric energy over the whole Lebanese territory. Already existing concessions are to be merged into EDL, each at the expiry period of its concession contract. At present, two small hydro-generation concessions and three small distribution concessions are still operating. The year 1976 culminated in the completion of the rural electrification networks in Lebanon, where an agglomeration of more than seven houses must, by law, enjoy the services of the electric distribution network. The 1975 civil war in Lebanon witnessed the gradual deterioration in quality of service and capacity of load supply of the public electric sector.

Throughout the lengthy war, the generation, transmission and distribution functions suffered partial destruction and consequent outages. Following the cease fire, a partial rehabilitation program was first carried out to reinstate, as much as possible, existing installations and equipments (costing ~ US$ 320 Million), followed by an expansion program to satisfy the growth in demand, mainly in the generation and transmission functions, at a total cost of US$ 1690 Million. These expenditures, in addition to the operation and maintenance costs, the high technical and non-technical losses, and the unpaid bills (residues from the 16 year long civil strife) left EDL in a state of undeclared bankruptcy and a reliance on the government of Lebanon (GoL) for constant financial support. The latter, burdened by the huge rehabilitation and reconstruction programs of the Lebanese infrastructure was borrowing at relatively high interests and ended up with a huge debt, where a large share of the national budget revenues are reserved to cover the debt service. Such a deteriorating financial situation of both EDL and GoL, as well as other less important factors, characterized the Lebanese electric power sector.

The long debates over the deteriorating electric sector, together with the government recent trend to abide by the World Bank advice to unbundle, regulate and restructure the sector and activate the participation of the private sector, led to the ratification of the law no 462, dated 9/4/2002 (Organization of the electric sector in Lebanon). In this law, the logic and requirements of a liberalized market, through the separation of policy, ownership and regulation are approached but not quite developed, and although ratified in the year 2002, the law has not yet been put into application. EDL is still functioning in compliance with the law 1964 (see # 6 below).

3.2 The Oil sector

Lebanon is not an oil producing country. Old and recent seismic tests, particularly in the Northern off-shore area, indicated positive results. Further tests and assessment are required to identify the storage potential and the market competitive value. Lebanon, therefore, imports the totality of its needs from the petroleum market. Until 1988, the Lebanese government retained a monopoly over the petroleum market, but at present some 8 private

companies are licensed to import, store and distribute refined products. Specifications of products are prepared and issued by the Ministry of Energy and Water (MEW)/ General Directorate of petroleum. Prices are also fixed by MEW and reflect international prices plus TVA (10%) and in the case of gasoline a substantial additional tax.

The Lebanese government owns two refineries (Zahrani & Beddawi) both of which are old and closed. Two closed crude oil pipelines use to supply the two refineries and export the surplus, one to Zahrani from Saudi-Arabia and the other to Beddawi from Iraq. Currently, no competition law exists, nor an autonomous regulatory body.

3.3 The Gas Sector

Lebanon is not a gas producing country. Old and recent seismic tests, particularly in the Northern off-shore area, indicated positive results. Further tests and assessment are also required to identify the storage potential and the market competitive value. The Lebanese market imports at present LPG mainly for domestic and commercial use, through a single licensed private importer. Prices are also fixed by MEW. Lebanon's recent government trend to shift to natural gas, starting with the power industry (thermal power plants, because of its multiple benefits), is to be extended later to other industries, commercial and residential activities.

An agreement to import part of the need from Syria has been ratified. A pipeline from Syria to the Baddawi plant in the North is near finishing. Another from the North to the South (probably off shore and DBOT) is under preparation (GASYLE II project). Furthermore, a multilateral agreement governing another pipeline "The Arab pipeline" from Egyptian sources to Jordan, Syria, Lebanon, Turkey and extended to Europe is taking shape, both on the institutional, administrative, financial, execution and operational levels between the regional forum. An LNG project has been given an initial study to ensure diversity of supply in case of need. No competition law exists, nor an autonomous regulatory body for natural gas.

3.4 The Renewable Energies Resources

3.4.1 Wind energy overview

Information on wind energy has been dependent on measurements taken by meteorological authorities, universities and research centres which led to indicative estimates of wind resources. Therefore the information available on wind resources is indicative but not sufficiently reliable for equipment design, sizing or performance evaluation. Since the economies of wind energy systems depend strongly on available wind speed in order to establish wind energy programmes, wind resource assessments should be adopted to provide high-quality and accurate wind data. A "National Wind Atlas" is called for. At present, only small pilot projects have been implemented in Lebanon and by private concerns

3.4.2 Small hydro-power stations

Compared to neighbouring countries, Lebanon enjoys sensible water resources gained during a rainy season extending during 80-85 days / year only. A quarter of these resources are being used presently. Numerous hydro-plants have been built early and in mid last century. Some of this wasted water may be recovered through building of dams and artificial lakes, as well as some small and medium hydro-power. MEW developed a 10-year program to develop national water resources (2005-2015). However, Priority is given for irrigation projects during the dry season. There is room to assess the real potential of hydro-power and the feasibility of each project.

3.4.3 Solar water heating systems (SWHS)

Unlike many neighbouring countries, SWHS remain marginal in the Lebanese energy balance representing less than 1%, which makes some few thousands TOE out of a potential market estimated to be more than a million TOE. Lebanon is rich in solar irradiation during 300 days a year, resulting in an average of 1800- 2000 KWh/ m^2. More than 80% of installed solar systems are locally manufactured by some 10 Lebanese industrialists that are mostly members of the "Lebanese Association of Solar Industrialists" (ALIS). The main barrier is the lack of institutional incentives for both customers and local manufacturers and the shortage of public awareness and absence of financial facilities.

Water heating in Lebanon is primarily carried out using electrical heaters; 70% of the residences are equipped with electrical water heaters; 10% with gas water heaters;10% with Oil boilers for water heating; and 5% with wooden water heaters.

3.4.4 Photovoltaic

Experts often look at the overall surface area of the globe as a recipient of solar energy capable of generating thousands of GWh of electricity, every day. They look up especially on rooftops of all buildings or brick ceilings and estimate the missing opportunity to install photovoltaic cells (solar electric generating stations) and profit from the daily free generated electric load, which is *"A potential, as far as the eye can see"*. Solar irradiation is readily available in Lebanon, however, the photovoltaic modules are still relatively inefficient, costly, and require large areas. Rooftops of single or few story apartments have been successful sites for this type of energy. Also, the replacement of brick ceilings by photovoltaic collectors could be viable solutions.

Because of the large space needed, the low efficiency, the high initial price and the short life span of energy storing equipment, photovoltaic units may be advantageous for individual use in remote areas as a standby for suppressed and/ or emergency outages, and is less attractive for micro-grids. The photovoltaic solution may have to await further technical development.

3.4.5-Biomass source

Few and limited rural exceptions in Lebanon depend at present on this resource through biogas digesters. However, with the actual development of the Lebanese society, we are observing nowadays an increase in domestic waste production (municipal solid waste). This goes with a parallel increase of the uncontrolled landfill areas all over the country.

Municipalities or grouping of municipalities may find biogas digesters an ideal solution to dispose of the solid waste and recover some useful load. The main difficulty encountered so far in Lebanon was to secure consensus on regional landfills, operate and manage technically (pollution free) the landfill, and finance any recovery projects.

The hybrid solutions for micro-grid projects, preferably connected to the nearby national grid, are realistic projects, especially on the municipal level. Knowing the meager municipal budgets of most villages and towns in Lebanon, attractive incentives and financial assistance are preconditions for a venture in this direction.

As for wood and charcoal as a biomass source, the quantity available is so small and is highly protected by law.

4. Lebanon's Electricity Profile

4.1 Primary Energy Consumptions

The primary energy consumption in Lebanon is given in Table 1 below. From 1995 to 2002 it shows a clear overall consumption increase trend. The drop in 1996 and 2000 are explained through the uneasy political situation of the country during the 6-day war in 1996 and events that preceded and the expectation that followed the Israeli withdrawal. The energy consumption among the sectors divides as 45% for the transportation, 25% for industry, and 30% for the residential and commercial sectors.

Table 1: Primary Energy Consumption.

Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Primary Energy Consumption (1000 TOE)	4,511	4,647	5,229	5,194	5,450	4,823	5,163	5,105
Yearly increase %	18.1	3.0	12.5	- 0.1	4.9	- 11.5	7.0	- 1.1
Primary Energy Consumption per Capita (TOE)	1.13	1.13	1.25	1.25	1.30	1.15	1.23	1.21

Source: **MEW**

4.2 Electric Energy Production and Consumption

The total electric energy consumption is shown in Table 2 below. The energy generated is also on the increase and the share of renewable is dropping since no new hydro-electric plant have recently been added to the system. The billed energy in 2002 was 54.4% of the total energy produced. Based on an estimated transmission and distribution losses of 12% and 5% for the internal use in power plant, then the non-technical losses are approximately 28.6% of the energy produced. This has dropped from an estimated 24.6% in 1996! The overall trend is graphically captured in Fig. 1.

The thermal and Hydro-Power Plants on the National Grid in 2003 are shown in Table 3. The total installed capacity in 2003 was about 2305 MW. The available capacity is about 1970 MW due to the derating of older units and of hydro-units derating during summer when the peak load occurs. A further 150 MW is available occasionally over the interconnection from Syria were occasionally available. A new 400 kV overhead line is under construction to connect to five other regional countries, which will increase the capacity by a further 400 MW after project completion.

Table 2: Electric Energy Generated and Purchased.

	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Total generated GWh	7,522	8,346	9,041	9,009	9,287	9,508	10,253
Percent hydraulic %	10.6	8.8	8.7	307	4.9	3.5	6.7
Total purchased GWh	1,427	1,265	1,381	1,144	1,835	1,575	1,155
Overall total GWh	8,949	9,611	10,422	10,153	11,122	11,083	11,408
Yearly Increase %		7.4	8.4	-2.58	9.5	-0.35	2.93
Billed Energy GWh	3,637	4,150	4,740	4,918	5,017	5,144	5,577

Source: **EDL**

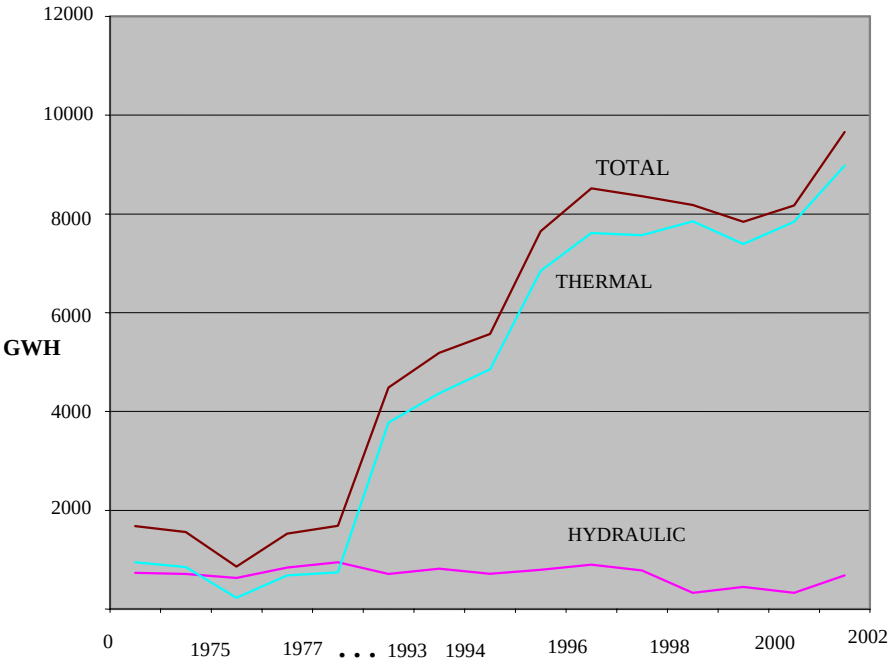

Fig. 1: Trend of Electric Energy Generation

Table 3: Thermal and Hydro-Power Plants on the National Grid in 2003

Power Plant	Installed Capacity		Commissioning Date	Date of Retirement	Type
	Nominal MW	Available MW			
Zouk (ST)	145	120	1984	2015	Fuel Oil
	145	120	1985	2015	Fuel Oil
	145	120	1986	2015	Fuel Oil
	172	170	1987	2015	Fuel Oil
Subtotal	607	530			
Jieh (ST)	62	55	1971	2010	Fuel Oil
	62	40	1972	2010	Fuel Oil
	69	65	1980	2010	Fuel Oil
	69	65	1981	2010	Fuel Oil
	69	65	1981	2010	Fuel Oil
Total	331	290			
Hrayche (ST)	75	60	1983	2010	HFO
Sour or Tyre (CT)	2x35	70	1996	2021	DO or NG
Baalbeck (CT)	2x35	70	1996	2021	DO or NG
Deir Ammar (CC)	3x145	425	1997 / 1999	2025-2030	DO or NG
Zahrani (CC)	3x145	425	1997 / 1999	2025-2030	DO or NG
Total Thermal	2,023	**1,890**			
Total Hydro	282	80	1932-1981		
Total	2305	**1970**			

It should be noted that the power plants of Jieh and Hrayche should be retired earlier, but cannot be spared yet, as the demand for energy still exceeds the generating capability of the system and load shedding schemes are implemented in summer during peak hours. This study estimates that the retirement date of Jieh and Hraiche (370 MW) will not take place before 2010, and Zouk (600 MW) not before 2015, thus taking into consideration this remark, the existing capacity becomes: 1600 MW in 2010 and 1000 MW in 2015, and hence capacity must be added to the system by 2010 and 2015. The inability to meet the peak demand is measured in Table 4 in which the peak demand and the peak power generated are compared for the years 1995 to 2002. It is clear from the deficit figures that great efforts have been done to reduce the dficit from 426 in 1995 to 159 MW in 2002.

Table 4: Peak Load Generated and Demanded in (MW): 1995 - 2002

Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Peak Generated	954	1,128	1,224	1,450	1,436	1,362	1,464	1,641
Peak Demanded	1,380	1,450	1,520	1,600	1,680	1,750	1,687	1,800
Percent Increase		5.1	4.8	5.3	5.0	4.2	4.0	6.7
Deficit (MW)	426	322	296	150	244	388	223	159

Source: **EDL**

The number of customers, the subscribed Power in A, and the consumed energy in kWh over the year 2002 based on different circuit breaker‘s ratings are shown in Table 5. The nature of consumption can be obtained from this table for different types of users. The average per capita yearly consumption for households with a CB less than or equal to 25 A is 1869 kWh. For CB in the range 30 to 100 A the per capita average yearly consumption is 3289 kWh or about 274 kWh/ month. The average number of low consumption customers (i.e. <2000 kWh/ year or <167 kWh/ month): 446383 customers, which are 41 % of total customers. Only about 0.5 % consume an average of 1539 KWh/ year or 128.5 kWh/ month). The percentage consumption by category is 45% at the low voltage, 23% for industry, 12% for administrative buildings, 5% for concessions, and 15% for technical losses.

Table 5: Number of Customers and Consumption

Circuit Breaker Rating (A)	Number of Customers 17/3/03	% Customers 17/3/03	Subscribed Power Amps. on 17/3/03	Total Cons. (1000 kWh)	Yearly Consumption kWh/ customer	% Cons.
5	5,458	0.50	27,290	8,398	1539	0.23
10	187,044	17.15	1,870,440	311,756	1667	8.63
15/ 3*5	16,472	1.51	247,080	40,160	2438	1.11
20	253,881	23.27	5,077,620	497,076	1958	13.76
25	6,500	.60	162,500	19,806	3047	0.55
Sub-Total	**469,355**	**43.03**	**7,384,930**	877,196	**1869**	**24.3**
30/ 3*10	199,602	**18.30**	5,988,060	**411,116**	**2060**	**11.4**
35	4,538		158,830	16,619	3662	
40	159,742		6,389,680	430,286	2694	
3*15	938		42,210	2,787	2971	

50	7,019		350,950	24,754	3527	
60/ 3*20	81,148		4,868,880	299,900	3696	
70	558		39,060	2,217	3973	
3*25	4,717		353,775	20,704	4389	
80	16,860		1,348,800	71,608	4247	
3*30	23,771		2,139,390	114,408	4813	
100	589		58,900	2,962	5028	
Sub-Total	**299,880**	**27.50**	**15,750,475**	986,234	**3289**	**27.3**

3*35	1,660		174,300	10,011	6030	
120/3*40	44,496		5,339,620	241,858	5435	
3*50	9,196		1,379,400	67,870	7380	
3*60	36,202		6,516,360	286,397	7911	
3*70	854		179,340	5,715	6692	
3*75	963		216,675	14,502	15059	
3*80	12,493		2,998,320	148,683	11901	
3*100	2,842		852,600	50,964	17932	
3*120	6,296		2,266,560	116,264	18466	
3*125	0		0	0	0	
3*150	948		426,600	27,417	28921	
3*160	1,617		776,160	54,437	33666	
3*175	0		0	0	0	
3*200	2,140		1,284,000	89,061	41617	
3*250	1		750	50,573	50573	
3*300	1,128		1,015,200	71,076	63011	
3*400	396		476,200	42,870	108257	
3*500	59		88,500	4,523	76660	
3*600	301		541,800	49,132	163228	
3*800	102		244,800	23,170	227153	
3*1000	95		285,000	24,517	258077	
3*1200	15		54,000	3,470	231334	
3*1600	14		67,200	6,548	467740	
Sub-Total	**121,818**	**11.17**	**25,182,285**	**1,338,535**	**109880**	**37**

Total	**1,090,655**	**100**	**54,305,750**	**3,613,083**	**3313**	**100**

Source: **EDL**

4.3 Private Power Generation

Private (autonomous) power generation (Partial extracts from Lebanon's Energy Inventory, 2003, prepared for the IPP-MSC Energy project for Lebanon):

According to Lebanon's Energy Inventory [2] there have been concerted efforts spent since 1992 to rehabilitate the electricity sector that was seriously damaged during the war. Nevertheless, the electricity supply was rarely continuous or steady, and as a result EDL has been forced to ration the demand for electric energy to a relatively large degree during the past 10 years. This rationing was due to many reasons some of which are structural and

others are circumstantial; the average Time of Power Feeding for the year 2001 and 2002 is shown in Table 6.

Table 6: Daily Hours of Feeding

	Beirut City	**Mount Lebanon**	**South**	**Bekaa**	**North**	**Daily average**	**% Feed**
Minimum	22.5	17	16.5	18.4	17.3	18.5 (July)	78.3
Maximum	24	23.7	23.3	23.62	23.4	23.6 (Nov.)	98.4

Source: **EDL**

As a result of the erratic supply of electricity and the bad quality of services, people had to revert to alternative power supply systems as back up, such as UPS for computers and other electronic and telecommunication equipment and private electric power generators. This situation encouraged the development of an independent and parallel network of autonomous producers estimated to be around 500 MW. In 2002, they generated about 1000 GWh of electricity. These autonomous producers are divided into 2 different groups:

a) The first class of autonomous producers produce electricity for their own consumption (e.g., residential buildings, factories, commercial centres, resorts, hospitals, hotels). Some of these producers are totally disconnected from the EDL grid (especially huge industries such as cement, paper and aluminium factories). The buildings equipped with auto power generators by Mohafaza is shown in Fig. 2.

b) The «neighbourhood generator» producers sell electricity via an independent micro network to a certain number of subscribers, always at a fixed rate, without meters, but depending on the subscription capacity {example: a 5 Amperes (1000 VA) capacity subscriber pays an average of US$ 20 a month whether he consumes or not). About 92% of households have access to neighbourhood generators in order to secure their minimal needs whenever there is a power shortage from EDL.

“The anarchical development of these power generators led and continues to lead to complex administrative, technical, environmental and judicial problems” [2].

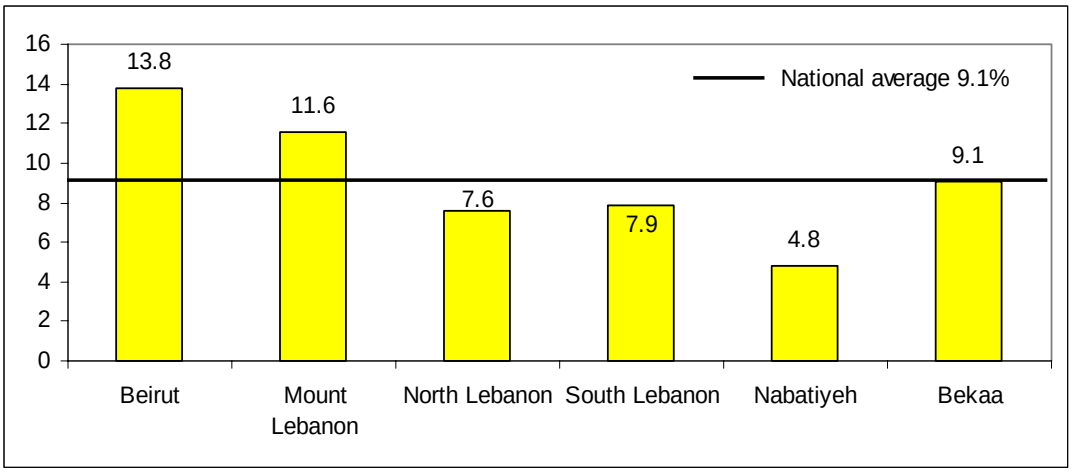

Fig. 2: Buildings equipped with auto-power generation

4.4 Electricity Tariff Structure

The Lebanese electricity tariff structure practiced at the low voltage level since 1994 is as shown in Table 7. Public lighting/ Public Administrations/ Hospitals/ Schools are charged a flat rate at 140 LL/ kWh, and crafts and agriculture are also charged at a flat rate of 115 LL/ kWh. It should be noted that depending on the fuel market price, the marginal cost of production ranges between US cents 8 / kWh at US$ 25/ BBL of crude oil to US cents 13/ kWh at US$ 50/ BBL. A fixed monthly subscription fee of LL 1,200/kVA and a rehabilitation fee are added to the bills. The rehabilitation fee is LL 5,000 for subscriptions whose capacity is up to 10 kVA, and 10,000 L.L. for subscription whose capacity is above 10 kVA. The invoice is subjected to Value Added Tax (VAT) equivalent to 10% of the final amount.

Table 6: Electricity Tariff at Low Voltage since 1994

	Current tariff 2003		
Monthly consumption kWh/ month	Rate LL/ kWh	Rate +10% VAT	
		LL/ kWh	US cents/ kWh
0-100	35	38.5	2.55
100-300	55	60.5	4.00
300-400	80	88	5.84
400-500	120	132	8.75
Over 500	200	220	14.60

Based on the above figures and those given in Table 5, which shows that about 43 % of customers consume less than 2000 kWh/ year, the present total electricity bill for a 2000 kWh/ year-customer, assuming 10 amps subscription is LL 183,400 per year (LL 15,283/ month or about US $ 10/ month. This is equivalent to 5 % of the minimum official salary and 3.18 % of the absolute poverty level.

The low consumers enjoy therefore a subsidy of at least 50-75 %. This subsidy is borne by EDL, while in fact it should be born by the government. Therefore, all consumers consuming less than 400 kWh/ month benefit from varying percentages of subsidy. Larger consumers (> 400 kWh/ month) are bearing higher tariffs on behalf of the low consumers.

5. Conclusions and Main Challenges

Collected facts and figures indicate the main characteristics and the challenges facing the Lebanese energy sector, as follows:

- Energy imports (98% is imported) are highly dependent on oil products resulting in a high energy import bill.
- Lately, natural gas (NG) has been decided to become a priority for thermal power plants and industry. The shift to NG is being slowly implemented, so far.
- There is still low integration and links to the Mediterranean networks of energy transport for the moment. Connections to regional energy networks exist via Syria only.
- High energy intensity (twice that of developed countries), leading to high energy related gas emissions.
- Aging of old power plants, and the need to scrap gradually old generating units. Lack of funds is delaying this action.

- Proper preventive maintenance of generating units, especially old ones, awaits spare parts and respected scheduled inspection and overhaul. Shortage of spare load and lack of funds is preventing them, resulting in unstable and insufficient energy supply.
- Weak related laws enforcement, causing high technical & non-technical electricity losses (~40-44 %) and comparatively high electricity cost.
- High penetration of de-central, private, small-scale power production capacities (estimated at 500 MW, producing ~ 10% of the total energy consumed in the country).
- Availability of sizable potential of hydropower, solar and other renewable energy sources.
- Very low use of renewable compared to neighbouring countries.
- Balancing actual load demand and satisfying yearly load growth have not been achieved for the last three decades, resulting in permanent load cuts, especially in the rural areas and made worse by emergency outages of unreliable units.
- There is a heavy government yearly subsidy, averaging at US $ 400 to 500 Million per year, to balance EDL expenditure with revenues. This has been made worse by the momentous rise in oil world prices.
- Shortages of funds from EDL and the Government of Lebanon form a barrier against newly needed expansion.
- Low electricity consumers benefit from important tariff subsidy born by EDL and high electricity consumers.

From the above, one concludes that the present situation of the electric sector is suffering from a combined technical, administrative and financial problems that have been worsened over the years.

6. Electricity Sector Reforms

As mentioned earlier in this report, the Lebanese government recent realization that electricity sector reforms is urgently needed decided to abide by the World Bank advice to unbundle, regulate and restructure the sector and activate the participation of the private sector. Hence, the ratification of the law no 462, dated 9/4/2002 (Organization of the electric sector in Lebanon). In this law, the logic and requirements of a liberalized market, through the separation of policy, ownership and regulation are approached but not quite developed, and although ratified in the year 2002, the law has not yet been put into application. EDL is still functioning in compliance with the old 1964 law.

Law no 462 provided for the unbundling of the vertically integrated single monopoly sector, at first, into three state owned joint-stock separate companies, denominated “Privatized companies” (one for generation, a second for transmission, the third for distribution). Within two years, a maximum of 40 % of the shares of generation and distribution companies will be sold to private investors, while the transmission company remains permanently state-owned. At a later stage, the remaining shares owned by the Lebanese State shall be offered to investors from the private sector.

In addition an independent sector regulatory body (National electricity regulatory body NERB) shall be created to monitor and control the electricity sector. A close scrutiny of the law indicates the need to modify certain provisions to make it applicable in a real free and competitive market. Furthermore, due to the interrelationships of the various energy forms, an “Energy law” to cover all forms of energy to replace the “Electricity law”, together with a single “Energy regulatory body” to replace the “Electricity regulatory body” are called for.

However, the Lebanese Government has not set yet a road map for the implementation of the provisions of this law.

7. Conclusions and Recommendations for Lebanon

In spite of the important subsidy granted to low level electricity consumers in Lebanon, the electricity tariffs remain higher than those of neighbouring countries. Recent tariff studies concluded that gradual tariffs increase for consumers is required to achieve the real marginal overall cost incurred by EDL. A tariff increase is bound to touch the poor through, either a general tariff increase of all consumption levels, merger of the low consumption levels, or raising the fixed subscription charges.

Of course, the immediate priority of EDL is to reduce both network technical losses from about 15% to about 10%, and the network non-technical losses from about 25 % to a maximum of 3 %, and collect all its issued bills. Even if this target is achieved, EDL revenues will remain short of its expenditures, especially with the current international fuel prices.

The speedy shift to natural gas in the thermal power plants and the upgrading of operation and maintenance (O & M) in them, would certainly alleviate the deficit incurred and improve the quality and sustainability of service.

Another important and immediate factor of benefit to all parties concerned (EDL, consumers and local manufacturers) is the quick implementation of solar hot water heating systems (SWHS), through incentive legislation and financial facilities. The same goes for the fluorescent-compact lamps.

Lebanon has gone a long way in ratifying a buildings isolation code (voluntary application up to the year 2010, and compulsory application after that), and is attempting to create a Lebanese centre for energy conservation (LCEC) to help launch energy services companies (ESCO). However, standardisation and labelling of electrical equipment have not been addressed so far.

Keeping in mind the above, the question remains: “Will the energy policy proposed reforms lift the Lebanese electricity sector from its pitiful and near bankruptcy state?

Three main parties are involved in this sector:

a) The government represented by MEW as an energy policy and strategy maker and the party that will be “ratifying” and supporting the legislation.
b) The private sector which will be the main operating partner and perhaps the sole operator in the future.
c) The regulatory body as an independent body monitoring and controlling the whole sector.

Success depends on how well each party plays its role, staying off limits of the others’ role and keeping non-concerned parties from unwarranted interference (politicians in particular). Success means better availability and reliability of the electric network and lower marginal electricity cost. It also means better market attraction to investors. Success also affects directly all categories of households, though indirectly, the poor and the low income households.

8. References

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