

ELECTRICITY

I. Electricity Sector Overview

The subject of securing electrical energy supplies from renewable and non-renewable sources represents today a strategic priority and a key driver for achieving sustainable development in any community or in any nation. This trend is clearly reflected in the strategies adopted by countries seeking to develop their energy sector, and in their continuing calls to expand the scope of use in their energy mix, not only as a feasible solution to meet the growing demand for energy, but also as a strategic option geared at the eradication of poverty and the improvement of opportunities for accessing water, food, health and education services, not to say the least, in the contribution to economic development.

Experts, academics and workers in this sector have always called on executives and decision-makers to take a strategic choice to generate enough energy so as to establish a lasting source that takes into the account the need to protect the environment from consuming non-renewable fossil fuels, and to open up the way for upgrading social aspects, ecological balance, and economic efficiency.

And since the Lebanese economy, like any other economy, is linked to a key variable represented in the traditional way of producing energies, its development stands against the challenges of energy availability, which confines the choice orientation towards fossil fuel resource management and the establishment of a sustainable formula for the supply and development, accompanied with a low carbon emission policy. A stake we must adopt for re-po-

sitioning within the new global economic order through moving forward with a long-term strategy to develop key economic sectors to reach economic sustainability therefrom.

The expenditure by the Lebanese Government of not less than thirteen billion dollars to import fossil fuel material for EDL from 2005 until 2013, has pointed to the enormous subsidy for the sector by the state, which illustrates how challenging reforms have become for the Lebanese government to face in the foreseeable future.

Especially after the covenant it took upon itself to carry out the required reforms in order to transform the sector from a burden on the treasury and its economy to an effective sustainable nerve that would render a positive impact over the national income growth and consequently on the economy.

And for those who went along and followed well the course of events of the energy sector in Lebanon, will clearly see that the financial and the legislative realities, and the inability to implement the laws has led to the worsening of the many chronic problems that have hampered the core business and threatened the sectors and inflicted harsh damage to the national economy. The sector was made impossible to be tackled, unless a well rooted gradual reform policy capable of lifting all the aspects of the energy sectors including renewable energy and

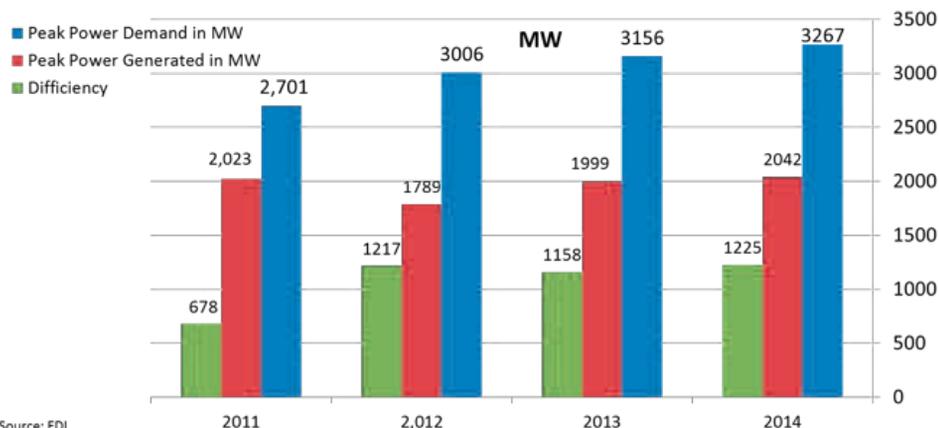
energy conservation is adopted. A comprehensive strategy for an energy sector system with all its details can constitute a mandatory continuous national policy. If supplemented with a realistic interim programmed policy it would expedite in the preparation, assemblage, auditing and documentation for an energy database for decisions to be built upon. Such policy can eventually lead to the preparation and ratification of modern laws that can guarantee to achieve the goals of the comprehensive strategy.

The Current Condition of the Sector

The electricity sector in Lebanon has entered a critical phase in terms of the production capacity deficit. The imperative issue requires reconsideration of the priorities in order to prevent further deterioration in the first phase, bridging the deficit in the second, and anchoring the required stability at the end.

In accordance with the Ministry of Energy and Water, the demand on electrical energy reached 20,036GWh in year 2014 (inclusive of the Syrian refugees demand), which can be approximated at an annual average of 2287MW of power demand, which is equivalent to 3267MW of peak power demand at a load factor of 70%.

The electrical energy produced and purchased in year 2014 reached 12,523GWh which accounts for an annual average of



1430MW of produced and purchased power or the equivalent of an annual peak of 2042MW of power. The current gap extended to 1225MW represents 38% at peak power demand, which is equivalent to 9 hours of daily rationing. Should this situation prevail, the gap is expected to increase and reach 1398 megawatts by the end of year 2015, which is equivalent to 41% of the demand, or about 10 hours of daily rationing.

Currently, the main effective peak capacity does not exceed 2042MW whereas the demand has surpassed 3260MW in 2014. Power generation in Lebanon is concentrated mainly on thermal energy production. Hydropower produced from plants does not exceed 4.5% from the total generation capacity in the country.

Power Supply from External Sources

Electric power is drawn from Syria to Lebanon through two main connection networks. The first network links Deir Nbouh plant in the north with the Tartous plant in Syria through two overhead lines of 120 megawatt capacity working on 220 kV of electrical pressure. The second network has a capacity of 80 megawatts through a single overhead line working on 66 KV of electrical pressure linking Aanjar substation plant with the Dimas plant in Syria. Lebanon has been drawing electrical power from Syria for a long

time now. In year 2000, Lebanon drew a peak 1418 million kilowatt-hour of electrical energy. It stabilized, at a later stage, at a yearly average of approximately 800 million kilowatt-hours, only 8% of the total power production or the equivalent of 90 megawatts of continuous power capacity throughout the year.

As for the Eight Arab connection network, and the electric energy purchase agreement from Egypt, the construction works and installations of the new Ksara HV substation have been completed. Efforts have succeeded in September 2009 to operate the new 400KV overhead lines, and terminate the new link with the Dimas transmission plant in Syria.

In year 2010, Lebanon benefited from approximately 120 megawatts of additional electrical capacity on the grid at an average feed of 21 hours per day, but the transfer was halted in year 2011. The new grid connection capacity can currently carry up to 300 megawatts of power. Lebanon is currently seeking to increase the import capacity from the countries of the region to cover for the remaining 180 megawatts.

The Main Problems of the Sector

- 1) The existence of high operational expenses:
 - The two combined cycle power plants in Zahrani and Deir Ammar, as well as the two open cycle power plants in Sour and

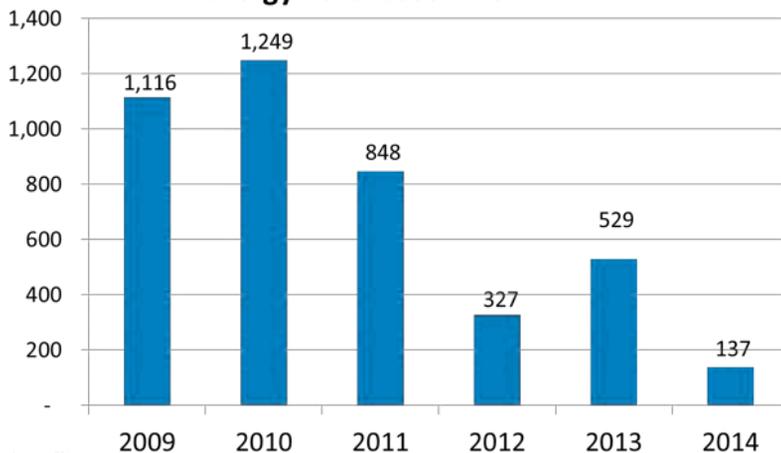
Baalback operate on Gas Oil (Diesel) rather than natural gas.

- The Zouk and Jiyeh thermal power plants operate with low efficiency, which necessitate periodical overhauling activities.
- The need to operate Sour and Baalback thermal power plants outside peak times.

2) The existence of rationing and the increase in power failures are due to following reasons:

- Insufficiency of current power generation to meet all the needs, a fact that led to the spread of the local private generation phenomenon.
- Low public investments since at least 12 years (not in the rehabilitation and maintenance of the plants nor in the construction of new ones).
- The incompleteness of the 220 kV transmission networks.
- The presence of the “bottle necks” on distribution networks and the increase of local breakdowns in crowded areas on peak times during summer and winter peaks.
- Loss of flexibility of electricity links between the old and the new grid.
- The absence of the usage of electronic accounting programs that study and organize the energy flow to ensure the supply and reduce the technical losses such as GIS.
- Deficiency in periodic maintenance operations by technical expertise for the main power plants, the substations, and the transmission network.
- High percentage of technical losses because of the incompleteness of the 220kV distribution grid, which varies from one area to another, exceeding in some areas the 15% average, to reach the 20% line in areas like the Bekaa.

Energy Purchased in GWh



Source: EDL



- The problems in the distribution network include:
 - The existence of old rusty steel distribution poles.
 - The inexistence of standby systems.
 - The inexistence of efficient monitoring of the meters.
 - The inability to prevent theft aggressions.
 - The inability to carry out required maintenance preventive measures.
 - The inability to match the billing preparation measures.
 - Collection and payment monitoring.
 - The ill issuance and control of bill settlements.
 - The loss of network components in some regions.
 - Significant shortage of required equipment tools and machinery necessary to improve and accelerate the needed interventions mainly due to the great financial deficit that EDL is experiencing.
- 3) The decline in financial returns of EDL are due to following reasons:
- The global increase in oil prices has aggravated EDL's budget and increased the debt and caused a financial shortage, which became an increasing burden and a source of concern for the national treasury.
 - The tariff structure hasn't been reconsidered since almost 15 years now. A transparent policy that decides whether electric energy is sold as a commodity or delivered as a service needs to be adopted.
 - Continuous aggressions and illegal connections on the network.
 - Incomplete bill collections.
- 4) The main institutional problems in the management of EDL are as a result of:
- An insufficient authority for the Board of Directors for taking ad-

equate decisions.

- Absence of clear criteria to evaluate the performance of EDL.
- Lack in technical training and difficulty in recruiting new qualified personell.
- Unavailability of reliable and transparent reports (statistics, finance, criteria, performance, etc.) represented, the least to say, in the inadequate account auditing since 2001.
- A huge deficiency in human resources represented by a present body of only 1902 employees when 5027 are needed; a vacancy for 3125 positions. The current body also loses 120 to 150 workers (8%) per annum due to retirement.

The Vision for the Future

In order to set in motion an efficient and sustainable sector, future visions to restructure the sector cannot be implemented unless the action plans include reform programs that would work on the short, medium and long terms in parallel. The reforms must encompass all the technical, financial and institutional aspects that would put in place an end to the financial deficit and ensure the auto-financing for future investments, as well as securing the good service at reasonable prices. Coordination efforts with the Ministry of Energy and Water is currently being carried out in order to crystallize a working paper, based on a medium term strategy, that will include working on the technical, economic, financial and institutional levels.

II. Main Accomplishments (1992 – 2014)

Main projects implemented by CDR for EDL during the 1992 – 2014 periods can be summarized as follows:

1) Generation

- Construction of two combined-cycle power plants in Deir Ammar and Zahrani with a capacity of 435 MW for each plant at a cost of US \$ 575 million,

achieved in 1999.

- Rehabilitation of thermal and hydraulic plants at a cost of US \$ 109 million, achieved in 1998.
- Construction of two open-cycle power plants in Sour and Baalback with a capacity of 70 MW for each plant at a cost of US \$ 61 million, achieved in 1996.
- The initiation of supply of a 120MW of electrical power from Egypt to the new HV transmission plant in Ksara through the Eight Arab connection network.

2) Transmission

The construction of the 220 kV network which included the installation of 339 km of overhead lines. Overhead lines that have been completely constructed are: Deir Nbouh to Ksara line, Ksara to Aaramoun line, Aaramoun to Zahrani and Sour line, and the Bahsas to Bsalim line passing through Halat.

- The construction of 220 kV substations in downtown Beirut, Aaramoun, Mkalles, El Horsh, Ras Beirut, Halat, Ksara, Bsalim, and Sour between 1999 and 2001.
- The construction of 61 km of underground buried cables for the 220 kV network in the North and in Beirut in 1999.
- The restructuring of the 150kV and 66 kV transmission networks in 1997.
- The construction of 400 kV network and substation in Ksara allowing for the power exchange between the countries of the region.
- Work on completing the 1900 meter run of the Mansourieh line, essentially after the conclusion of the report that was prepared by the Minister of Health on 5/11/2010, which concluded in the inexistence of any significant health risks attributed to the exposures of non-ionized electrical and magnetic fields.

3) Distribution

- Rehabilitation of the distribution networks in 1997 at a cost of US \$ 112 million.



III. Progress of works in 2014 - contracts awarded before 2014

- The electrical transmission network expansion project: all works related to the expansion project of the electrical transmission network have been completed as specified above, except for the works regarding the installation of cables on poles in Mansourieh – Ain Saadé – Ain Najm, due to the objections expressed by local residents of the area. Efforts are currently being made to resolve the issue. Completion of the works is expected to be sorted out in 2015, if all goes well.

- National Control and Dispatch center: works started during the month of July 2006. The project is funded by the Arab Fund for Economic and Social Development and its overall cost is evaluated at approximately US \$ 25 million. The project is expected to be completed during 2014 knowing that the proposed amendments have been considered.

After repeated halts, due to several reasons, works of the center were re-launched in year 2010. Phase one of the project, which comprised 63%, was undertaken by CDR. The specialists were relocated to the new center and commenced on the operation of the advanced control programs in 15 major substations that linked Mkallès, Ain Mraïseh, Mssaïleh, Gharbieh, Onesco, and Ras Beirut substations. The executed works are now estimated at 92%. They include all the works of the center, the connections with the major substations and with the power plants as well as the local testing and commissioning in all the major substations. The delays in connecting the center with the rest of the substations go back to the incompleteness of the Mansourieh link which incorporate the fiber optic lines that run in parallel with the high tension lines. This in turn hinders the

completion of the final testing and commissioning of some of the microwave lines. In addition, the need for securing some of the leased lines is currently being coordinated upon amongst EDL and the local concerned administrations.

The National Control Center currently monitors and controls 56 major substations and lies in wait for 15 others until connection problems are resolved.

- Rehabilitation and Expansion of Transmission and Distribution Networks in the Liberated regions:

The works for rehabilitation and expansion of the high tension 66KV transmission line and the 20KV/15 kV transmission distribution network in the liberated regions were awarded; however, the contract wasn't signed. The funding from the Iranian protocol was canceled. The total cost of the project was estimated at about \$ 25 million (US Dollars). CDR is currently seeking to secure alternative financing.

- The rehabilitation and Expansion Project of Al-Ayoun and Fneidek Transmission and Distribution Network in Akkar:

The completion of the 66KV line in Beit Mellat, in the area of Al-Ayoun and Fneidek in Akkar, has allowed the Beit Mellat substation, which was completed in February 2011, to be placed in operation. The 66KV line was completed in year 2012 right after the Kuwaiti funds and the bidding process were settled. The 5,150,000 euros project was designed to raise the transmission and distribution power capacity of the region from 10 to 40 MW.

- The Technical Assistance Projects for the Electricity Sector Reform Plan:

Right after an international tender was conducted during year 2007, three consulting service contracts were awarded that aimed at granting technical assistance within the framework

of the electricity sector reform plan as follows:

- In relation to the Ministry of Energy and Water:

Enhance the capacities of the Ministry of Energy and Water to implement the proposed reform actions in the sector policy statement. The main tasks assigned to the consultant were to assist the Ministry in the preparation of a national sector policy and fuel oil strategy. Part of the tasks was to review the proposals related to the supply of liquefied natural gas (LNG) to the Zahrani plant, and evaluate the proposals aimed at attracting private investments and reviewing previous studies regarding the establishment of the Electricity Sector Regulation Authority. Works are expected to be completed in September 2009.

Having secured the funds from the World Bank, CDR, in this respect, and in coordination with the Ministry of Energy and Water, entered into contract in October 2011 with Poten & Partners, a well-known consultancy specialized in strategic studies for building Liquefied Natural Gas facilities, in an effort to help select the best technology and site location for a suggested port aiming at securing the required Natural Gas quantities at the best possible price.

In April 2012, the Consultant completed all of the required tasks and submitted all the relevant reports, which contained:

- 1) A summary about existing worldwide LNG markets.
- 2) Lebanon's LNG demand up until year 2030.
- 3) A summary about the main LNG suppliers.



4) A detailed preliminary study for designing an LNG port after carrying out site assessments to 3 locations (Deir Ammar power plant, Zahrani power plant, and the Setaata area).

5) Three reports related to the Preliminary Environmental Impact Assessments of the 3 sites.

6) One report concerning the existing legal current conditions and the legal frames that should govern this sector.

7) The necessary capacity building for the specialists at CDR and at the Ministry of Water and Energy.

8) The preparation of the "EOI" (Expression of Interest) Terms of Reference for companies interested in bidding to build and operate a sea port for importing LNG including the purchase and operation of the Floating Station Regasification unit (FSRU) and the building of the sea port for receiving LNG through harboring the ships for emptying its loads. The goal of this TOR is to prepare a short list of qualified companies for invitations for bidding.

In completion to what was required, and in cooperation with the Ministry of Energy and Water, CDR entered into contract, through local funding, with the same consultant in October 2012, to perform the second phase of these strategic studies.

The consultant completed the required tasks in August 2013 and submitted the following reports:

1) Terms of Reference for the selection of consultants willing to conduct the Environmental Impact Assessments in support for the development of the Floating Station Regasification Unit to regasify LNG.

2) Term of Reference for the se-

lection of the developer of the FSRU.

3) Help in selecting 4 companies capable of importing LNG to Lebanon.

4) Help to evaluate companies' bids for the development of the FSRU.

5) A report covering the training works required for the staff of the local institutions.

- As for EDL: The improvement of the operational and financial performance of EDL, where the main duties of the consultant will be the preparation of a plan for improving the efficiency of power generation plants and for assisting in the implementation procedures. Reorganizing the supply duties of EDL, establishing the priorities for reducing technical and non-technical losses, providing assistance to complete current projects, organizing an inventory of assets and survey of audited financial reports and preparing the tender documents for the financial audit contract covering 2005 and 2006 are also included in the tasks. Consultancy services are expected to be completed in May 2009.

- As for the Higher Council for Privatization: To provide the necessary support for the Higher Council for Privatization for incorporating EDL in conformity with the Electricity Sector Regulation Law and the Ministry's plan for restructuring the sector. The tasks are to propose the organizational structures for companies that will emanate from EDL, including the detailed description of the proposed positions and the procedures to be followed; along with the preparation the preliminary work plans for these companies. It is also required to organize the inventory of assets and determine the capital levels and the share structure of these companies.

Right at the finish line of the first phase of the contract, CDR, entered into a contract with Booz and Co. to undertake another

complementing study to the first phase in order to provide the Higher Council for Privatization with the required support in corporatizing EDL. The contract was signed in cooperation with the Ministry of Energy and Water and under finance from the World Bank. Booz and Co completed the studies by the end of May 2012 and submitted the reports related to the detailed implementation procedures to execute the plan.

It should be noted that the estimated total cost of the technical assistance contracts are of approximately US \$ 6.5 million, distributed in the following manner:

US \$ 5 million from the World Bank grant, about US \$1 million from the French Development Agency grant, and US \$ 500,000 from local funds to cover for the local tax expenses.

The designated consultants are to submit their reports gradually in due time in accordance with their terms of references, where the revisions by the concerned institutions are expected to constitute an opportunity for a close coordination amongst the involved parties that will facilitate the decision making process regarding the electricity sector reforms.

- The Comprehensive Master Plan for the Generation and Transmission of Power: Electricité de France (EDF), which was placed in charge of drafting the Master Plan from a grant financed by the French government, has submitted a draft report regarding power generation. Based on the discussions with concerned officials over the remarks, EDF issued the second version of the report in June 2008 with expectations to issue the final version in 2010.

IV. Main Projects Under Preparation (2015 - 2016)

Generation sector:

- o The rehabilitation of Zouk and



Jiyyeh power plants:

	Unit number	Installed Capacity in MW	Actual capacity in MW
Jiyyeh plant	1	62	52
	2	62	38
	3	69	58
	4	69	57
	5	69	54
	Total	331	259

	Unit number	Installed Capacity in MW	Actual capacity in MW
Zouk plant	1	145	90
	2	145	-
	3	145	92
	4	172	110
	-	-	-
	Total	607	292

The installed and actual capacities of the Zouk and Jiyyeh power plant units are as follows: The total installed capacity of both Zouk and Jiyyeh power plants are 938 MW, whereas the average effective operational capacity is 551 MW. EDL is currently conducting the rehabilitation feasibility study for the 2 plants, in addition to detailed studies and the preparation of the tender documents. The Arab Fund for Economic and Social Development expressed its readiness to finance the rehabilitation of units 3, 4 and 5 of the Jiyyeh power plant (since units 1 and 2 which were erected in 1970 are expected to be replaced) as well as all the four units of the Zouk power plant in accordance with a 5 to 6 year work plan schedule. Once fulfilled, the rehabilitation is expected to raise the effective capacity of both plants to 800 MW, in addition to the preparation of the required provisions for the replacement of units 1 and 2 of the Jiyyeh power plant. Award-

ing of the rehabilitation project is expected to start in 2015.

o Construction of New Generation Plants: Based on the first outcomes of the master plan conducted by EDF, various proposed options to construct new power plants are overlaid. The Ministry of Energy and Water awarded a contract for the erection of a new power plant in Deir Ammar, and another for the erection of new generation units in Zouk and Jieh power plants.

o CDR signed a contract with the consulting group "Mott Macdonald /Pan Arab Consulting Engineering/ Clyde and Co LLP" to help the Ministry of Energy and Water in November 21, 2013, to assist the Ministry of Energy and Water in preparing required feasibility studies for the addition of 1500MW of electric power capacity generation through Public Private Partnership schemes. The consultant completed the first phase tasks in July, 2014, and the second phase tasks in June of year 2015.

o Power transfer from Steamers: the contract between the Ministry of Energy and Water and one of the Turkish companies is expected to continue during year 2014. The two steamers secure close to 270MW of power in Zouk and Jieh power plants.

Transmission sector:

o Construction of substations in various regions:

Amongst the current priorities are the five substations that have been determined to treat the suffocations witnessed on the transmission networks, mainly at: The Southern Suburbs (Dahieh), Bahsas (Tripoli), Marina (Dbayeh), and Ashrafieh.

Technical Assistance and Sectoral Studies:

o The Master Plan Study for Distribution in Beirut and its Suburbs:

Following EDL's request from CDR to seek funding for the Master Plan study for the Power Distribution in the Greater Beirut area, the French Agency for Development (AFD) has expressed its willingness to finance the study through a grant. The consultant EDF, who prepared the Master Plan of 1998, is expected to be nominated to carry out the works, which are anticipated to be finalized in 2015.

The Master Plan of the Greater Beirut area includes: the updating of the Master Plan of 1998 for the city of Beirut, the area extended from Mkalles to Aaramoun, in addition to the Master Plan for the southern and northern suburbs.





Power Plant Deir Aamar



Control Center For Advanced Power Management



FatimaGul Ship for Power Generation



Eight Countries Interconnection Network -Ksara Station

Electricity Completed, Ongoing & Under Preparation Projects

