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**THE ENERGY RELEVANT ENVIRONMENTAL ISSUES
IN THE POWER AND INDUSTRIAL SECTORS OF LEBANON**

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***THE ENERGY RELEVANT ENVIRONMENTAL
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SECTORS OF LEBANON***

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THE ENERGY RELEVANT ENVIRONMENTAL ISSUES IN THE POWER AND INDUSTRIAL SECTORS OF LEBANON

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Abstract:

Electric power plants, cement factories and the few other industries that burn fossil fuels emit several pollutants linked to the environmental problems of acid rain, urban ozone and the possibility of global climate change.

The pollution contribution in the power sector in Lebanon is dominated by the thermal electric power plants; in the industrial sector by the cement factories, followed by the iron and steel production. Many of the existing industrial establishments have been set up in residential areas in and around Beirut, and represent a challenge for regulators and environmental policy makers.

This paper on "the energy relevant environmental issues in the power and industrial sectors of Lebanon" addresses the following topics:

***Identification of the major energy relevant environmental issues in the Lebanese power and industrial sectors;*

***Existing strategies considered to alleviate the environmental risks in the subject sectors, including policy and institutional measures, standards and technological options;*

***Recommended procedures and institutional links for implementing environmental standards in Lebanon and the barriers facing their implementation.*

Background :

Current Energy Sector Status in Lebanon

Apart from a small amount of hydro- electric power and biomass (2-3% of total primary energy supply), and a new power tie to Syria, Lebanon is entirely dependent on imports of fossil fuel for energy. The power sector accounts for about a third of fuel imports, while the transport sector consumes nearly 45% and the industrial about 15%. The 1997 Energy bill amounted to USM\$ 840, nearly 10% of total Lebanese imports.

At the present rate increase, energy consumption will double in 10-12 years.

There is a considerable potential use of solar energy, yet this source is virtually unexploited

Pollution of the Environment

The energy sector is the major contributor to pollution of the environment. In 1997, the combustion of the total energy produces in Lebanon emitted " 15000 tons of dust, 85000 tons of SO₂, 45000 tons of NO_x and 3.5 million tons of CO₂ (3).

Environmental Legislation

Currently, Lebanon has no environmental legislation to deal with environmental issues. A draft environmental law has been approved by the outgoing government and is yet to be submitted to the parliament for its consideration. The draft law includes a section dealing with "pollution charges and fines, the emission and the

ambient quality standards. The draft law calls also for Environmental Impact Assessment (EIA) prerequisite studies.

I- Energy relevant environmental issues in Lebanon

Energy consumption, as indicated above, is bound to generate pollution of the environment and raises environmental issues that need to be seriously tackled.

The major energy consumers and emission producers are:

*****The Power Sector, namely:**

- ++ Thermal electricity generation through the electric utilities.
- ++ Private thermal generation of electricity, both residential and commercial.

*****The industries, namely:**

- ++ The manufacturing industries and construction schemes.

*****Consumers in the agricultural/forestry/fishing sector.**

*****The transport sector, namely:**

- ++ Road, domestic aviation, national navigation.

This paper shall discuss the power and industrial sectors only.

☒ The Power Sector

The power sector, in particular, thermal electric power plants emissions are dominating factors in three major environmental issues :

i-Acid rain: emitted in power plants chimneys gradually reacting with water vapor of the atmospheric air and forming the precipitating acids.

The fossil fuel combustion is responsible for the emission of Carbon dioxide CO₂, Oxides of nitrogen NO_x, Sulfur dioxide SO₂, Volatile organic compounds VOCs, and to a lesser extent Methane CH₄, Carbon monoxide CO, Nitrous oxide N₂O.

A "1994 inventory of green house gas (GHG) total emissions by sources and removal by sinks" indicated that the share of the power sector from the total emissions is as follows (2):

Gas type	Power sector contribution percent
CO ₂	34
NO _x	18
SO ₂	58
VOCs	0
CH ₄	5
CO	0
N ₂ O	24

An inventory of these gases is to be effected every year. However, little change in these percentages is expected to have taken place since 1994.

ii-Urban Ozone: The power sector, particularly electric power plants, contribute heavily to NO_x along with particulate matters. Large concentrations of Ozone often occur in and downwind of large urban areas (1).

iii-Global climate Change :Fossil fuel combustion is responsible of around 80% of carbon dioxide CO₂ emission as well as other gases purporting to climate change and global warming.

iv-Lubricating and hydraulic oil spilling and drainage: Lubricating and hydraulic oil is another source of contamination to soil chemistry. EDL generates about 230 tons of spent lubricating oil which is, so far, disposed to drain, while private generators dispose of nearly 94 tons wasted in dumps, mostly on land.

Little quality recycling is practiced (3).

v-Land acquisition and rights- of- way: A major environmental constraint resulting from electric generation and transmission networks and main substations stretching all over the tiny Lebanese territory and the limited availability of land , not least along the totality of the coastal area, are and were bound to arise .Technical requirements often crossed human settlements, conflicted with rights-of-way, encountered agricultural land , dislocated animal habitats, impacted on landscaping, resulting in conflicts with land owners.

vi-Technical and non-technical losses: Energy, mainly electric energy, is greatly wasted and misused in Lebanon. Technical losses in transmission and distribution networks exceed by 5-7% the normal value; the non-technical losses due to theft and illegal connections, though being reduced gradually over the last few years, are still around 40%.

Energy control and optimization reduces load growth (currently 5-6% /annum) and reflects positively on the environment(5).

In addition to the above environmental parameters, interest in the End-use efficiency and conservation, as a viable alternative to meet growth in power demand, was not expressed nor was it addressed during the war and the few years that followed.

Lebanon finds itself today without the proper mechanism and framework to confront the end-use energy conservation issues and strategies in a meaningful and comprehensive manner.

The Industrial Sector

The above referred to "1994 inventory of GHG emissions by sources and removal by sinks", indicated that the share of the industrial sector in the total emissions is as follows(2):

Gas type	Manufacturing Industries percent
CO ₂	27
NO _x	14
SO ₂	31
VOCs	3
CH ₄	4
CO	5
N ₂ O	22

i-Standalone Private Generators: The industrial sector in Lebanon is characterized by the wide spread of standalone generators to provide for personal electricity needs.

With the triple tariff imposed by EDL on industrialists and the high price fixed during the peaks of the evenings, an increasing number of industrialists relied more and more on self-generation rather than the national grid.

ii- Major sources of pollution: The manufacturing industries, of which the cement industry is the major source of CO₂ and SO₂ emissions (respectively 76% and 67% of total emissions of this sector), followed by the iron and steel industry(21% and 8%) , is a major source of pollution(2).

iii- Industrial Establishments in Lebanon

A 1994 census identified over 23000 industrial units with 84% employing fewer than 10 workers. The average employment of 5.9 workers/unit suggests the existence of a few large enterprises and a very large informal sector of small enterprises. Half of the largest enterprises are concentrated in food processing and beverages, clothing, cement and building products. Furthermore, 57% of the industrial workforce are concentrated in Mount Lebanon and Greater Beirut Area(4).

As mentioned above, many of the smaller industrial establishments have been set up in residential areas in and around Beirut and represent a challenge for regulators and environmental policy makers.

II-Existing strategies to alleviate the environmental risks:

Lebanon faces a large environmental agenda covering all sectoral activities. The energy sector is in the forefront .

In contrast with this agenda, there is only a limited amount of resources- financial, institutional, technical, human- that can be made available.

Consequently, following rehabilitation of the environmental damage caused by the war, two major objectives can be defined for the environmental strategy in Lebanon:

*- To develop preventive tools to ensure environmentally sound development at a lower cost for society.

*- To prevent further degradation of natural and cultural assets (4).

Measures relative to the Energy Sector as a whole

The following measures have or are being taken relative to the energy sector as a whole:

⇒GHG Inventory

Develop the first inventory of greenhouse gas emissions by sources and removals by sinks in Lebanon, taking the year 1994 as a base line year. This inventory is to be yearly updated as stipulated by the 1992 Rio de Janeiro convention on climate change.

⇒clean air quality limits

Based on the law no 216 dated 31/10/1992, which require the setting of constants allowing the Ministry of Environment to adopt, as a basic measure, to protect the environment from pollution, the Minister of Environment issued the decree no 20/B dated 2/11/1994 setting the maximum emission limits of different gas types (SO₂, NO₂, O₃, CO, Pb, particulates, black smoke, ...

⇒ Safety standards

“ Safety standards” related to oil storage, transport and distribution have been enacted by the Ministry of Petroleum (MOP) (Decree no 71 dated 10/4/1939).

Measures relative to the power sector

⇒ ↑↑ quality control of imported fossil fuel

Closer monitoring and quality control of imported fuel oil for EDL use. Samples from tankers are collected, prior to unloading and analyzed for compliance with tenders specifications. Approved laboratories (two at least) analyze samples. Whole shipments may be rejected if specified limits are exceeded.

⇒ ↑↑ Sulfur content of fuel oil

EDL committed itself to reduce overall emissions to ensure adequate ambient air quality and minimize hazards to health. It has limited fuel-oil import to power plants to max. 1% sulfur content, at least in residential areas. Presently, EDL imports 1% fuel-oil to the Zouk power plant, incurring an average of \$8/ ton price difference and 2% sulfur content to the two other steam generated plants.

The prohibitive price difference does not warrant going to lower sulfur content (0.35-0.50%), as requested by some environmentalists in Lebanon.

⇒ ↑↑ Flue gas de-sulfurization plants

A plan to treat the exhaust gas emissions from thermal power plants chimneys was seriously considered by EDL, thus low grade fuel oil would be used with little harm to the environment.

This plan has been frozen and a switch to higher grade fuel containing 1% sulfur as a more economic and environmentally sound solution.

⇒ ↑↑ Combined cycle generation technology

The combined cycle generation technology has been adopted by EDL because of its higher efficiency (46-47%), nearly 10-12% more efficient than the conventional fuel oil fired steam cycle. Environmental benefits, in the reduction of pollutants emissions are secured, more so, if natural gas replaces diesel oil as a future fuel.

⇒ ↑↑ Natural gas

Substantial environmental benefits arise from the burning of natural gas, provided long term procurement and economic transport are secured.

Natural gas emits, in combustion, 26% less CO₂ than fuel-oil, less NO_x and hardly any sulfur or particulates. Substantial cost savings in fuel prices, maintenance costs and longer life of electric generating units are expected.

The future prospects for natural gas market in Lebanon are good. The Lebanese government, together with EDL, have anticipated a gradual shift to gas, thus reducing the impacts of the high import bill on Lebanon's balance of payment as well as the friendly impact on environment.

The two new combined power plants at Beddawi and Zahrani were designed to burn dual fuel- diesel fuel and natural gas.

A pipeline link from the gas fields in Syria, stretching along the Lebanese coast up to the Zahrani plant, is presently under study to cover the needs of the Baddawi and Zahrani plants. Additional deliveries in the future may be envisaged as Syria explores more wells and if Lebanon turns to repower and converts some of the existing plants to natural gas.

⇒ ↑↑ Liquefied Natural Gas (LNG)

The Lebanese government and EDL have been, for some time, considering import of LNG to Lebanon, mainly for electric power generation

A feasibility study on the whole gas issue in Lebanon, in particular LNG and its future prospects financed by the American Agency for Trading and Development USTDA, is expected to be completed by the end of 1999

⇒ ↑↑ New and renewable energy

Lebanon has a good regime of sunshine and wind, with about 2500-3000 hours of annual sunny hours and 2000- 2200 Kwh/m² of average yearly irradiation.

In spite of a favorable situation from both geographic and social stands, not much attention has been given by the government and the private sector to promote the development of such sources of energy, not even the substitution of electric hot water heaters, that are wide spread in residential houses and consume power heavily, by solar hot water heaters.

New and renewable energy are virtually unexploited in Lebanon.

A great void is to be filled.

⇒ ↑↑ Environment Impact Assessment (EIA)

EDL committed itself to minimize and eliminate negative environmental impacts associated with the provision of electrical services to its customers.

In the sector's expansion, environmentally friendly technologies for power generation and careful design and location of power transmission and distribution systems were secured within possible geographic limitations

Measures relative to the industry sector

The industry sector in Lebanon is characterized by a quasi total absence of environmental regulations. Popular pressure and mass-media campaigns have helped in mitigating pollutant gas emissions especially in cement factories

Regular official monitoring and control is yet to be performed.

GHG inventory, clean air quality limits and safety standards, referred to above, are measures applicable to the industry sector as well.

Additional measures:

⇒ ↑↑↑ Energy efficiency and demand side management (DSM)

The energy intensity in 1997 in Lebanon was 0.65 Toe/ 1000US\$, about 2.2 higher than the average of the OECD countries.

The Lebanese situation is characterized by a:

**Lack of a national policy on DSM.

**Lack of a national policy on the rational use of energy.

**Absence of legislation that affects the sales of energy-efficient devices, the policies for labeling, national testing protocols and standardization of appliances and energy related equipment

LIBNOR, the semi-governmental institution responsible for the promulgation of Lebanese specifications and standards has been dormant throughout the civil war with practically no funds and no qualified human resources

Very recently, it has acquired some funds and started on the move. However, much is needed to be done

⇒↑↑Standalone generators

The recent triple tariffs of electricity imposed by EDL on industrialists has negatively affected the environment, as many of them found it more economical to rely partially or fully on self generation from their standalone generators. And since many industrial locations are not far from residential areas, gas emissions must have increased in proportion.

⇒↑↑Electrostatic filters

Cement factories in Chekka- north of Lebanon , under popular pressure, installed at the outlet of their chimneys electro-static air filters to secure a clean exhaust gas from their chimneys .Some other factories are still resisting the public demand for a cleaner environment.

Energy- environment additional supporting activities:

A number of additional activities - public- private – international organizations – foreign governments sponsored – etc... have been launched in Lebanon . The aim is to establish an effective and reliable basis for the assessment of energy-environment related issues. They may be classified under five major categories: On-going, expected to start, under consideration, pending and completed.

Most of these projects reflect concerns over :

- ❖ Policy and institutional measures.
- ❖ Energy conservation targets in various fields of activities.
- ❖ Assessment of type and efficiency of final energy consumption.
- ❖ Formulation of short and long term energy policy.
- ❖ Promotion of renewable energy.
- ❖ Establishment and operation of an Energy Management Center (EMC).
- ❖ Advising and assisting the public and the private sectors in elaborating energy plans at national levels.
- ❖ Creation of a Ministry of Energy??
- ❖ Analyzing the future role of the private sector in the whole energy field, in particular in the electricity sector.

These efforts , in spite of their urgency are still in their initial rethinking stages with hardly any implementation strategies and many barriers to overcome.

III- Barriers facing environmental standards in Lebanon – Recommended procedures and institutional links for implementing them

The energy sector in Lebanon faces several barriers that hinder the formulation and implementation of a clear and approved national policy and standards. These barriers are to be viewed in conjunction with the energy misuse of the war years, especially in the electricity sector, where cheap electricity, illegal connections and unpaid bills created huge but, hopefully, *temporary barriers* that are to be added to the general set of key barriers to energy efficiency, energy conservation and diversification and the use of renewable energy.

The following barriers were identified:

III-1 Temporary barriers:

Shortage of data on energy demand, demand patterns, consumers irrational habits, weak law enforcement regarding energy theft and unpaid bills, lack of awareness

among decision makers, planners and end users, including private sector slackness of mass-media to disseminate topic.

III-2 Information , awareness and economic barriers:

Decision makers in Lebanon have, so far, reflected unawareness and /or unfamiliarity with the scope of favorable economic and environmental impacts as a result of applying energy conservation measures. Both decision makers and consumers have also ignored the importance of standardization, measuring and labeling of end user appliances and equipment , the life cycle economic benefits, the urgent needs to develop the local market and control low efficiency products imports.

Furthermore, the private sector, especially the commercial sector, has expressed a clear reluctance to develop and improve the local market for energy efficient measures and equipment, may be for fear of loss of material gain if market is quality controlled.

Economic comparisons of conservation and supply alternatives to meet demands and quality service to customers within the energy sector have often neglected associated costs.

The impacts due to energy pollution created environmental damages to human health, irreversible environmental degradation and loss of natural resources, loss of amenity and quality of life and economic losses.

These damages, mainly due to polluted air emissions, are viewed by many economists as “ externalities” and an inefficiency of the market when power rates do not reflect nor rate payers directly pay, the associated social costs (1).

Lately however, quantifiable environmental costs and benefits were included among the direct costs of the energy resources, and methodologies to measure the real costs incurred due to these emissions and add them to the “internal traditional” costs, are being perfected.

Such costs, though complex and controversial, if adopted in Lebanon, are bound to reflect on energy pricing, market transactions and shapes energy policies and regulations.

III-3 Institutional and legal barriers:

Lebanon has, so far, abstained from formulating, adopting and promulgating an energy sector policy on the national level capable of securing cost energy savings in all sectors, in particular in the power and industrial sectors. In spite of the existence of an official “*Committee for energy conservation*” formed in 1982 under the auspices of the Ministry of Industry (MOI), the said Committee never met and little has been done on the regulatory measures to curb future growth in energy demands and to advance consumers participation, through awareness programs and economic incentives.

The present situation may be pictured in an absence of :

- **Mechanisms to address energy issues on a comprehensive and sustainable basis.
- **National conservation and demand side management (DSM) plans.
- **Standards, measuring protocols and labelling .
- **Sufficient capacity among relevant government agencies to audit, monitor and plan.
In short, institutional ,legal, informing ,capacity building, economic bodies,... are priorities to establish and implement

►► National Energy Conservation Agency (NECA)

The first should be consideration by the Lebanese government is the creation of a “*National Energy Conservation Agency (NECA)*”, which would be an independent agency under the Office of the Prime Minister. As a first step and in view of the officially expressed desire of the present Lebanese government to merge MHER and MOP into a single “*Energy Ministry*”, an “*Energy Conservation Center (ECC)*”, within the premises of MHER, could be established, whose main task is the Promotion of energy conservation and energy saving targets and strategies, Demand Side Management (DSM), development of private sector energy service companies (ESCOS), development and use of new and renewable energy, monitoring and coordinating energy conservation projects and advising the government and concerned stakeholders in the elaboration of energy plans at national and local levels. The ECC activities and frame work should be bound within full harmonization with relevant environmental standards accredited in the energy sector and subject to approved environmental impact assessment studies, whenever required.

►► Phasing out policy options – short- medium and long term:

● In the short term:

- Promote the ECC under MHER , establish its institutional set-up and its core of trained personnel with a view to ensure sustainability .
- Coordinate all activities of the power sector , so as to avoid duplication and discordance.
- Update and enforce existing laws , standards and labels.
- Control and monitor quality of fuel procured, at all times.
- Procure fuel with low pollutants content, especially sulfur content.
- Speed up studies and implementation plans of natural gas
- Plan and execute pilot projects on energy conservation and renewable energy starting with insulation of buildings- solar hot water heaters- fluo compact lamps.
- Start enhancing the role of NGO’s and ESCOS.

● In the medium term:

- ++ Establish means of regular measuring and monitoring of gas emissions from the power and industrial sectors.
- ++ Propose and analyze mitigation methods.
- ++ Install filters for gas emissions, whenever justifiable – cement factories for example.
- ++ Keep up the policy favoring natural gas consumption in the energy sector.
- ++ Develop DSM , especially in the electricity sector. Review tariff structure.
- ++ Develop awareness campaigns on energy savings, in partnerships with the private sector . Encourage NGO,s and ESCOS to move full speed ahead.
- ++ Finalise EIA decrees covering power and industrial projects.
- ++ LIBNOR to speed up standardization, testing procedures and labeling, especially energy efficient appliances.
- ++ Review rules and regulations,so as to include in them various forms of incentives and deterrents.
- ++ Go to larger pilot projects and secure funds for them . Aim for a larger role of the private sector.

● ***In the long term :***

- Establish the real cost of energy, by including "Environmental Externalities" in the traditionally computed costs thus, implementing a "real cost policy".
- Generalize the use of natural gas as a friendly source of energy.
- Develop further DSM on both the supply and load management sides.
- Consolidate the Energy Conservation Center (ECC) and restructure it into a National Energy Conservation Agency (NECA) under the Prime Minister's.
- Develop and implement official energy policies on the end-use side as well as related to new and renewable energy.
- Implement EIA (Environmental Impact Assessment) procedures and guidelines.
- Elaborate sizable pilot projects inspired by environmental considerations and seek international funding for execution.

Conclusion:

Energy scenarios, that have been developed in the last few years, could not ignore that environmental issues transcend local and regional frontiers and interact within the whole world. Hence, sustainable energy options took a global form, attracted common interests, activated international cooperation and favored technology transfer to developing countries.

These options envisaged a more rational use of energy, innovative technologies to reduce the polluting effects of fossil fuels, favoring natural gas consumption and the development of the environmentally friendly renewable energy.

Lebanon, partially because of war consequences and effects, partially as a result of both governmental and popular unawareness, remained unaffected by these energy development and trends.

So much, that energy caused environmental degradation, inflicted a heavy financial, social and economic burden on the country. The usually enlightened and pioneering private sector did not, in this domain, react to the challenge, may be for lack of motives.

An enlightened and futuristic energy policy on a national scale is now a priority, an environmental necessity and an economic urgency.

In this short paper, we have attempted to identify the environmental issues in the power and industrial sectors in Lebanon, list the existing strategies and regulations, analyze barriers and recommend short, medium and long term solutions.

Intensive local and regional efforts are urgently needed.