Environment and Renewable Energies in Lebanon

BLOMINVEST BANK

June 21, 2014

Contact Information

Research Asisstant: Riwa Daou

riwa.daou@blominvestbank.com

Head of Research: Marwan Mikhael

marwan.mikhael@blominvestbank.com

Research Department

Tel: +961 1 743 300 ext:1256

Over the years, having a greener and healthier environment has been a goal of growing importance around the globe. Today, economies not only seek growth but also take stock of the externalities it might generate on the environment and consequently on public health and social welfare. Growth and development now answer to the concept of "sustainability" according to which the wellbeing of present generations should not compromise that of future generations.

The following lines offer a brief overview of the state of the environment in Lebanon and explore the field of renewable energies, powerful tools in combatting scarcity of natural resources and pollution. Before delving into the details, the importance of environmental concerns would be better perceived in monetary terms. According to the World Bank, the cost of environmental degradation[1] in Lebanon has been estimated at $800M in 2005 or 3.7% of GDP. The cost of water pollution represented 1.08% of GDP followed by 0.7% for air, 0.69% for coastal zones and cultural heritage, 0.61% for soil pollution and wildlife, 0.09% for solid waste and 0.53% for the global environment.

The lack of standards and regulations and the absence of a comprehensive environmental strategy were behind the low ranking of Lebanon on environmental indices worldwide. Lebanon therefore ranked 91st out of 178 countries on the Environmental Performance Index (EPI) 2014 issued by Yale University. The results give a clearer view on the country's environmental strengths and weaknesses. On the Brightside, Lebanon was at the 19th position on the component that indicates the loss in forested area from 2000 to 2012. Lebanon also benefitted from an elevated score of 91.77 out of 100 on the child mortality sub- index. However, Lebanon scored poorly on the issue of biodiversity and habitat which tracks the protection level of terrestrial and marine areas as well as endangered and threatened species. In this regard, Lebanon received a score of 1.71 out of 100 and was positioned at the 173th spot amongst 178 countries.

Lebanon also needs to make progress in terms of air quality, where he ranked 98th out of 178 countries. Air pollution is determined by the exposure to fine particle matter (PM), which, at elevated levels, can be harmful to the lungs and to the heart. In terms of PM exposure, Lebanon's score over a 10-year stretch indicates a 13.35% decline in this grade. Moreover, Lebanon's score on the index which tracks the excess of particle matter in the air posted a double-digit drop of 20.75% over the past 10 years. In addition, data from the World Bank shows that carbon dioxide emissions grew by 11% in 2008, 26% in 2009 and only dropped by 2% in the year 2010 to 20,403 kilotons (kt).

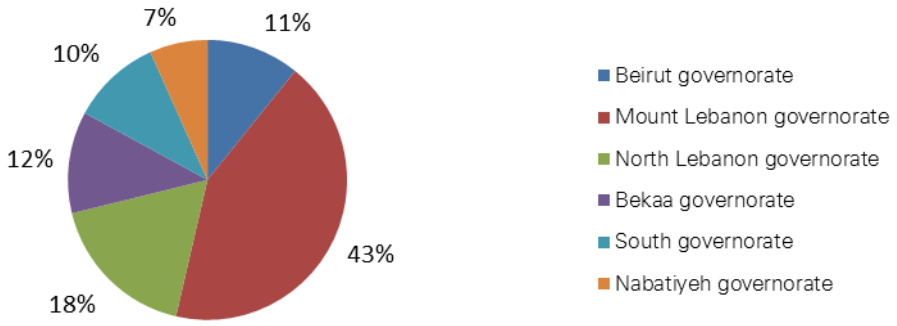
[1] The World Bank defines the cost of environmental degradation as follows: "the lost welfare of a nation due to environmental degradation. Such a loss may include loss of healthy life and well-being (premature death, absence of clean environment), economic losses (reduced soil productivity), and loss of environmental opportunities (reduced recreational value for beaches, forests)."

Water: A Renewable Energy Source in Need of Rehabilitation and New Prospects

A major trend affecting the safety and the availability of water resources in Lebanon is population growth. With the recent influx of Syrian refugees, water resources are expected to be strained. According to the World Bank, following the influx of Syrian refugees through August 2013 demand for water has increased from 335 million m^3/year (MCM/Year) to 361.1 MCM/Year.

More particularly, it's the rapid growth rate of the urban population that is affecting the water supply. As shown in the graph below, the majority of households are concentrated in urban areas such as the governorate of Mount Lebanon, where 43% of the Lebanese households reside.

Concentration of households in 2009



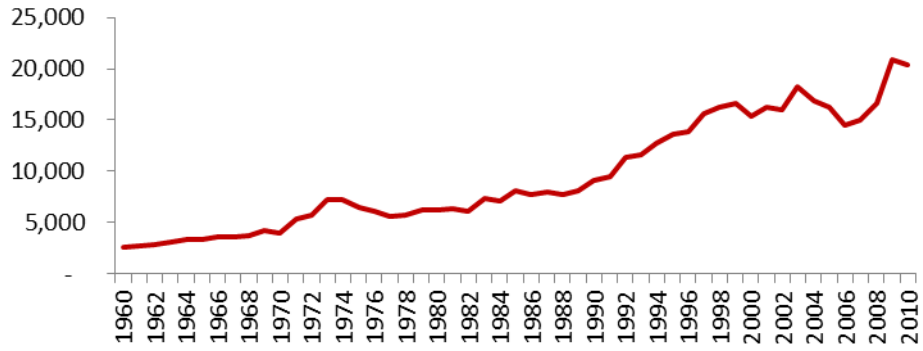
Source: Central Administration of Statistics

According to the Ministry of Environment, the elevated water demand in urban areas has compelled establishments to pump additional quantities from wells. Therefore some aquifers have been depleted and others suffered from salt water intrusions. The heavy demand has also generated production of untreated wastewater.

Wastewater treatment plants (WWTP) can prevent the contamination of fresh and clean water streams. WWTPs are not only necessary for health and environmental reasons, but they can also be used to generate energy. Using a technology called Anaerobic Digestion (AD), treatment plants will process wastewater and sludge (semi-solid waste left from industrial wastewater) and can generate electricity, heat, transport fuel and fertilizers. These treatment plants may not only rely on wastewater sewage sludge but can also require the acquisition of feed-stocks such as slurry (cement mixed with water per example) and manures (animal excrement). Therefore the feasibility study of the WWTPs should take into consideration the acquisition cost of the feed-stock, the transport cost and the reliability of supply.

Since WWTPs are environmentally friendly, a study led by CEDRO showed that five plants in Sour, Aabde, Sarafand, Saida and Majdal Anjar are qualified for the installation of AD technology. The five plants in addition to an AD plant already implemented in Tripoli are expected to produce total primary energy of 143,000 Mega Watts per hour (MWH) and to slash greenhouse gas emissions by 35,000 tons of CO2 equivalent. The figure below shows that carbon dioxide emissions have been on a persistent upward trend in Lebanon over the period 1960-2010.

Carbon Dioxide Emission in Lebanon (In kilotons)



Source: The World Bank

Reducing greenhouse gas emissions is the key for climate change prevention. Increased levels of greenhouse gases in the atmosphere would translate into higher temperatures, longer periods of drought, less rainfall and therefore less water in the country's streams.

Providing a rough estimate of the cost and revenue dynamics of these WWTPs is necessary especially for a country like Lebanon where the public deficit is soaring to more than 10% of GDP. CEDRO concluded that the maintenance cost of an AD plant is typically 2 to 3% of its capital value. However, studies showed that these costs can vary significantly from 4,000 euros on capital cost of just under 500,000 euros and up to 72,000 euros on a capital cost of just below 1 million euros.

As for the revenues of these plants, two scenarios can be drawn. The electricity produced by the plants can either be rewarded via a feed-in- tariff or via sale of the electricity on the wholesale market. What is a feed-in-tariff (FIT)? A FIT is a government financial subsidy which guarantees a payment per unit of electricity produced through renewable energy for a number of years. 70% of European Union member states apply this method. However, the downside is that the tariff is fixed over a number of years which can deter AD developers from updating the technology and rendering it more efficient.

Aside from wastewater treatment plants, Lebanon has several hydroelectric units that feed on river water.

Lebanon's hydropower capacity already stands at 282 MW or 8.7% of total nationally produced power in the beginning of 2013. However, CEDRO states that most of the hydroelectric units have exceeded their technical lifetime and are either out of service or are producing only a fraction of their total capacity.

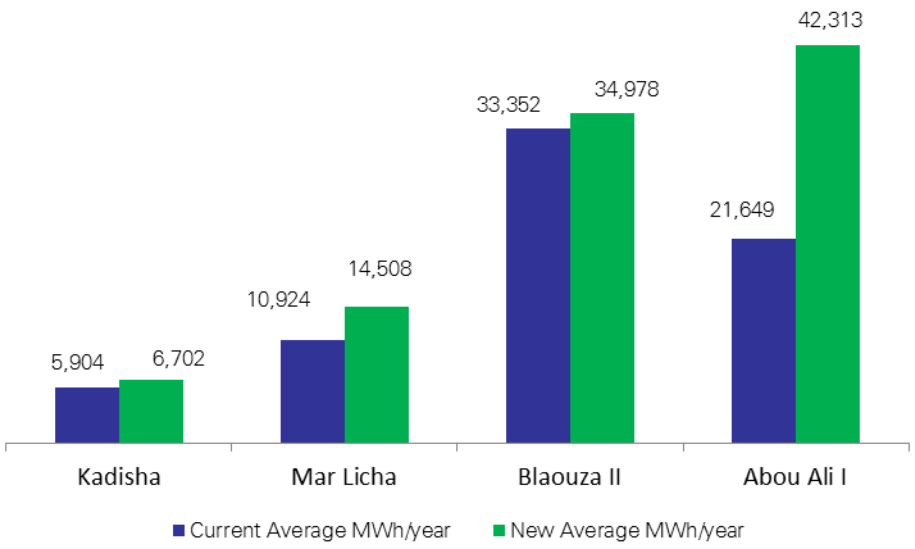
Table of Current Hydroelectric Fleet

River Stream	Plant Name	Year of Installation	MW Installed Capacity
Litani	Markabi, Awali, Joun	1961, 1964, 1967	199
Nahr Ibrahim	Chouane, Yahchouch, Fitri	1961,1955, 1951	32
Kadisha Valley	Bechare, Mar Licha, Blaouza II, Abu-Ali	1924, 1957, 1961, 1932	21
Nahr Al Bared	Al Bared 1, Al Bared 2	1936	17
Safa Spring	Richamaya - Safa	1931	13
Total Installed Capacity in MW	282		

Source: CEDRO, Hydropower in Lebanon, History and Prospects

According to CEDRO, rehabilitation works on the Kadisha plant, the Mar Licha plant, the Blaouza II plant and the Abou Ali I plant can significantly increase capacity. Moreover, the investment required to rehabilitate the Kadisha hydro plant can pay itself within a maximum of 4 years.

Effect of Rehabilitation and Upgrade of the Hydropower Plants

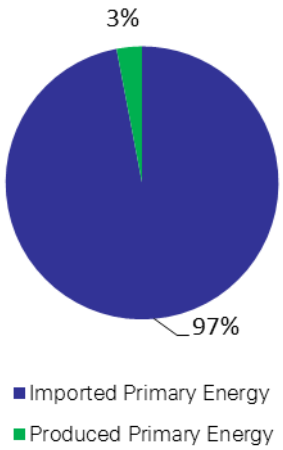


Source: CEDRO, Hydropower in Lebanon, History and Prospects

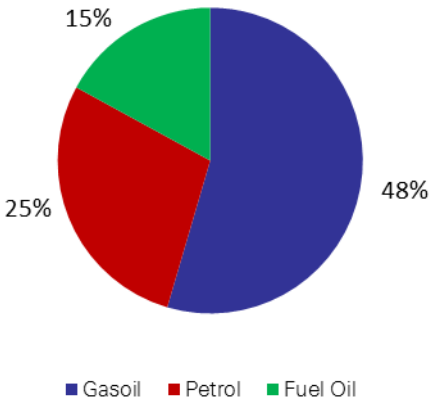
Solar Energy: A Renewable Energy Source Gaining Ground

With around 300 days of sunshine per year, it seems more than justified for Lebanon to make good use of solar energy and to benefit from this alternative power source. First, Lebanon contributed only to 3% of the total primary energy supply (TPES) in 2012. In doing so, it mostly relied on the expensive and environmentally harmful gasoil and fuel oil as shown in the diagrams below.

Breakdown of Total Primary Energy Supply in 2012



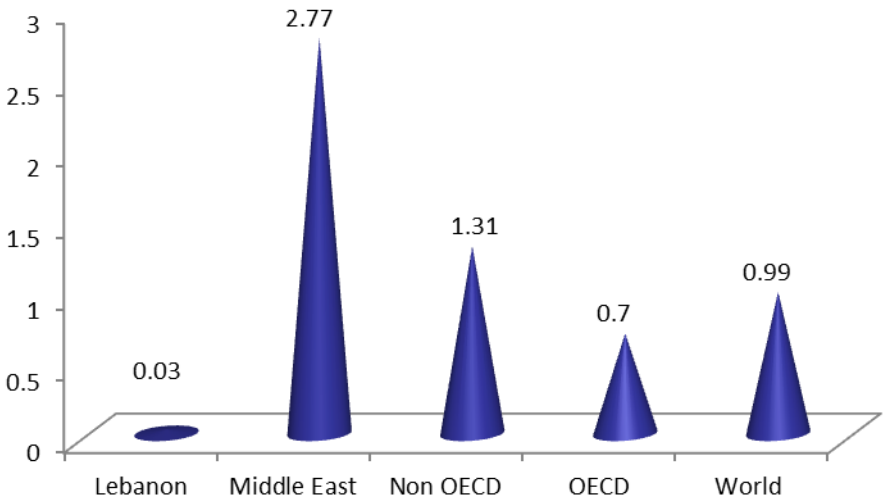
Most used Energy Sources in 2012



Source: ALMEE, Energy Balances 2012

Therefore, Lebanon ranks poorly in terms of energetic self-sufficiency, when compared to regional and international peers.

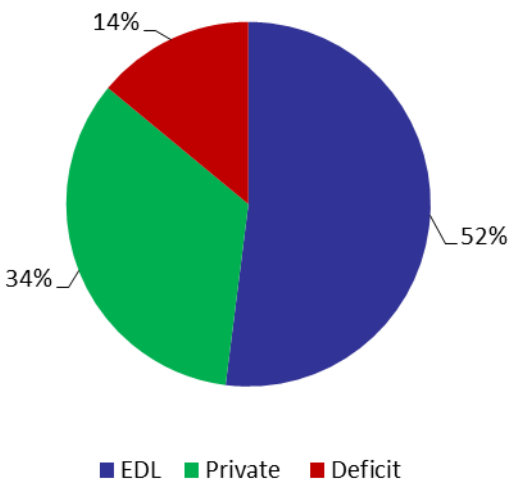
Energy Production/TPES



Source: ALMEE, Energetic Balances 2012

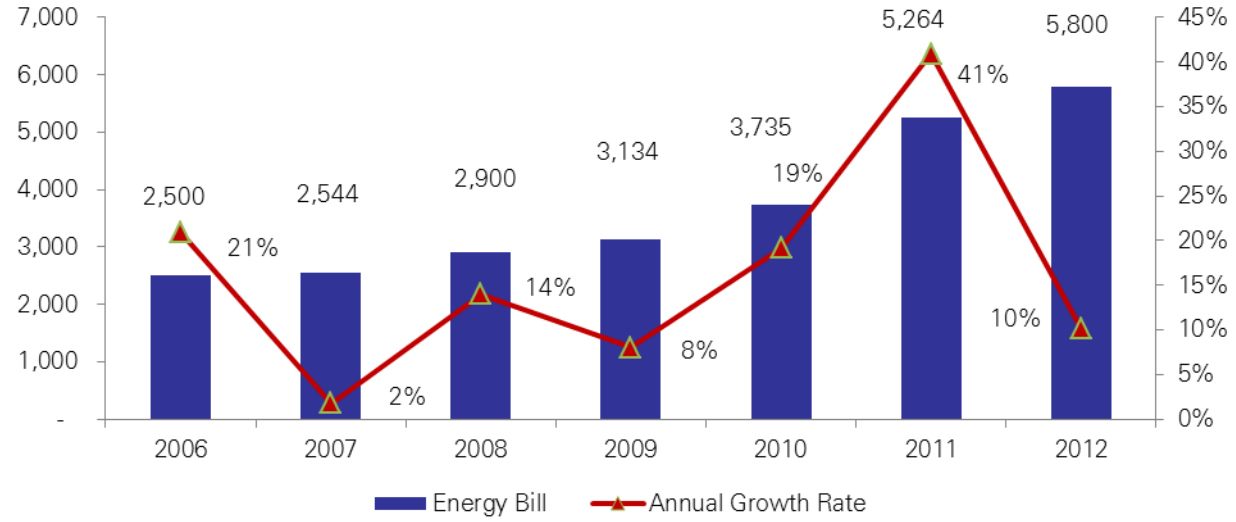
Second, Lebanon suffers from an electricity deficit according to which supply is well below demand. The country has several hours of power outages, during which electricity demand is met by private generators. In 2012, EDL produced 9,000 GWH of electricity while private generators produced 6,000 GWH. Third, the energy bill has soared over the past years, going from $2.5B in 2006 to $5.8B in 2012.

Lebanon's Electricity Deficit



Source: ALMEE, Energetic Balances 2012

Energy Bill (In Millions of $)



Source: ALMEE, Energetic Balances 2012

In sum, Lebanon has a meager energetic self-sufficiency, uses harmful fuels for energy production, suffers from an electricity deficit and its energy bill is incessantly growing. All these deficiencies corroborate the use of solar energy and render it more interesting to evaluate the market's status, with a special focus on solar water heating.

In the residential and commercial segments alike, solar water heating awareness is elevated. According to figures from the Lebanese Center for Energy Conservation (LCEC), the area covered by solar water heaters exceeded forecasts in 2012 and in 2013. The expected value for 2012 was 287,988 square meters (sqm) while the actual value stood at 326,766 sqm for that same year. Similarly in 2013, the forecasted value was 325,988 sqm while the actual value totaled 412,532 sqm. Accordingly, the market value has increased from $6.18M in 2012 to $6.39M in 2013.

In March 2014, the first national survey on solar water heaters was conducted as part of a project managed by the UNDP. The UNDP gathered information from the residential, commercial, suppliers' side and interviewed both users and non-users of solar energy.

The survey showed that, on average a residence installs a solar water heater with a capacity of 359 liters and a collection area of 5.64 sqm. The satisfaction rate amongst users reached 90% and was due to the availability of hot water at all times and due to the lower electricity bill.

Users of solar water heaters noted that their electricity bill was slashed by 42% while non-users estimate the cost-saving of solar water heating at only 35%. Since users and non-users have different perceptions of the cost-saving benefits of solar water heaters, their willingness to pay also differs. Non-users reported an average willingness to pay of $651 per system, well below the cost of $1,114 reported by users.

In the commercial segment, the average collection area is 47 sqm/system with an average capacity of 1,833 liters. Users of solar water heaters have paid an average of $16,000 for their installation, which is much higher than the willingness to pay of non-users.

On the supply side, 62% of dealers import their products while the rest install locally made products. Around 70% get their products from China or Turkey. 79% of dealers of solar water heaters have reported a growth in demand in the past 6 years and linked this progress to the subsidy program for renewable energies led by the Ministry of Energy and Water and to the awareness raising campaigns. Figures from the LCEC also show that the highest company service coverage for solar water heating is in Mount Lebanon, followed by Beirut and North Lebanon.

Wind Energy: Budding Potential for Lebanon

At the 2009 Copenhagen Conference Lebanon pledged to meet 12% of its energy demand through renewable energy sources by 2020. Producing electricity through wind power can help the country get closer to this target. We will start by assessing the air quality in Lebanon and then discuss how this resource can be used to generate electricity.

The average cost of degradation of air quality in Lebanon has been estimated at $170M in 2004 by the World Bank. Air pollution stems from several factors such as the burning of oil and fossil fuels, industrial and manufacturing processes as well as construction activities. The cement industry, in particular, is the largest contributor to CO2 emissions in Lebanon.

Annual Cost of Air Quality Degradation in 2004

	Cost in $M/year
Urban Air Pollution from Lead Emission	28-40
Urban Air Pollution from Particle Matter	26
Indoor Air Pollution	10-46
Total Costs from Outdoor/Indoor Air Pollution and Loss of Quality of Life	112-225

Source: The World Bank, Cost of Environmental Degradation, the Case of Lebanon and Tunisia

Fortunately, there are several ways to enhance the air quality in Lebanon: Increase reforestation activity, raise awareness for fuel-efficient vehicles and modernize the private and public transport fleets. On the longer term, turning to environmentally friendly power generation remains the most beneficial measure.

In 2013, a joint-venture between Hawa Akkar, a Lebanese firm, Greece-based Construction Contractors Company (CCC), and China-based wind turbine manufacturer Goldwind won the tender to build the first wind-power farm in Lebanon. The companies have a combined turnover of $8 billion, and 16,000 MW of installed wind power.

With a capacity of 60 Mega Watts (MW), the wind-farm is expected to provide light for 60,000 homes in the underserved region of Akkar. The wind farm will produce electricity and then sell it to the Electricité du Liban (EDL) since private sector involvement in energy production is prohibited whereas leasing energy to the state-owned EDL is allowed.

Overall, Lebanon has poured efforts into the renewable energy field, especially in terms of solar energy. However, much more needs to be done to halt the degradation of the environment and prevent global warming from threatening the country's moderate Mediterranean climate. Lebanon needs to preserve its forest cover and create a legal framework that protects land and marine areas.

For your Queries:

BLOMINVEST BANK s.a.l.
Research Department
Verdun, Rashid Karameh Str.
POBOX 11-1540 Riad El Soloh
Beirut 1107 2080 Lebanon

Tel: +961 1 743 300 Ext: 1283
research@blominvestbank.com

Marwan Mikhael, Head of Research
marwan.mikhael@blominvestbank.com
+961 1 743 300 Ext: 1234