Mediterranean Solar (hot) Spot – Preparation Phase - Lebanon Fact Sheet

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Lebanon

30 June 2011

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1. Fundamentals of sustainable Energy

Lebanon is located in Western Asia with 10,452 square kilometres of area and a population of about 4 million (2010 est.); the urban population is about 87%. The real GDP per capita for 2010 is more than 10,000 US $ and the annual growth rate is around 7%.

1.1. National Energy Context

Lebanon is a country largely devoid of fossil energy. Lebanon is not currently an oil or coal producer. Exploration has revealed the existence of oilfields in the Bekaa West plain as well as offshore along the North and West coast. The "Oil's Law" has been recently adopted by the parliament and a bill to open this market to the private sector in the form of DBOO (Design, Build, Own and Operate) or DBOT (Design - Build - Operate – Transfer) is currently under development.

The energy consumed is totally based on imported oil derivatives. Use of any form of RE is very limited in Lebanon. Electricity is supplied by "Electricité du Liban" (EDL), an autonomous state owned entity. EDL has the monopoly of **production, transportation and distribution** of electricity. In 2004 the installed capacity amounted to 2310 MW and 98% of the population was connected to the system. Work is in progress on the rehabilitation of the high voltage transmission networks, which are currently planned for completion by the end of year 2011 (220 kV). There are very few concessions for the distribution of electricity, that date to more than 35 years ago and which represent a maximum of **5%** of the total production and distribution volume, but no licenses at all. Losses, both technical and non-technical, are unusually high. Currently they represent **34%** of electricity produced. This includes some 14% in technical losses and about 20% in non-payment of electricity bills and power theft. The principal objective of the distribution plan is to reduce these losses to a normal rate between 10 and 15%. Despite the progress made, electricity rationing still occurs (10 to 16h per day), in the regions outside Beirut (and 3 hours and more per day in Beirut). Because of this rationing, private illegal small electricity producers, spread all over the country, are producing and selling electricity without getting connected to the main grid but through independent cables tied on the electricity and telephone beams. A 6 to 8% growth in electricity demand is expected, which will require the simultaneous strengthening and extension of the network.

Lebanon has some waterways and suitable sites that have allowed the exploitation, at different levels, of several hydroelectric power plants (about fifteen with an aggregate nominal power of 280 MW). The country also benefits from neighbouring oil producing countries and keeping privileged relationships with them. It was linked to some of them by pipelines (Iraq and Saudi Arabia) running into two oil refineries (Tripoli in the North and Zahrani in the South on the Mediterranean Sea, actually not in operation).

1.2. Institutional organisation of the energy sector

The institutional entity in charge of the energy sector is the Ministry of Energy and Water (MEW). It issues carbohydrates import licenses to private companies (22 companies at present), establishes fuel specifications, fixes their prices and controls their quality and their stoking and distribution security.

For some years now, MEW has been importing the fuel allotted to "Electricité du Liban" (EDL) of which it is the supervising authority; EDL should pay the corresponding bill. Since the end of hostilities in 1990, the successive governments' main priority has been the rehabilitation of the energy sector which suffered greatly during twenty years of war. Later, there was more focus on the sector's growth to satisfy the increasing demand for energy and to ensure a secure and stable supply, a necessary condition for the economic development of the country.

On the other hand, the policy of fixing energy rates based on relatively low prices, so-called "social prices," has inhibited the development of energy efficiency and encouraged wasting of energy. In this context, one must note that EDL suffers chronic losses. The deficit for the sole year 2009 came to more than one and half billion U.S. $ and the deficit for the sole year 2010 came to more than 2.2 billion U.S. $. This was due to the cumulative effect of the huge technical and non-technical losses estimated at 40% in 2010, the payments arrears and a price policy which does not reflect the real generation cost.

Electricity Tariffs Low Voltage 2010			
Consumption (kWh/month)	Tariff (LL/kWh)		Tariff (€/kWh)
<100	35		0.026
101-300	55		0.041
301-400	80		0.06
401-500	120		0.09
>500	200		0.15
Small to Medium Industry	115		0.086
Agriculture	115		0.086
Public sector	140		0.105
Electricity Tariffs Medium Voltage 2010			
Industry and Hotels		Tariff (LL/kWh)	Tariff (€/kWh)
	Advanced rate	320	0.24
	Normal rate	112	0.084
	Night rate	80	0.06

Table 1: Electricity Tariffs in Lebanon (2010) – Source EDL

Electric power billing is done by parts of 100 kWh; all the five parts are billed at prices still lower than the marginal cost of electric power generation (estimated at 18 cents$/kWh in 2010 and at 24 cents$/kWh in 2011).

1.3. Figures and trends related to energy consumption

The energy sector structure did not change in 2009; almost 98 % of our primary energy needs were imported. These imports are mainly based on oil by-products (Figure 1).

In 2009 the total supply in primary energy reached 6,735 kTOE, an increase of 3.5 % yearly since 2000 (figure 2). Gasoline represented 26%, gas-oil 42% and fuel oil 20%, i.e. almost 88% of the total for only these three products. The rest of the energy carriers have less than 3% in the primary energy mix.

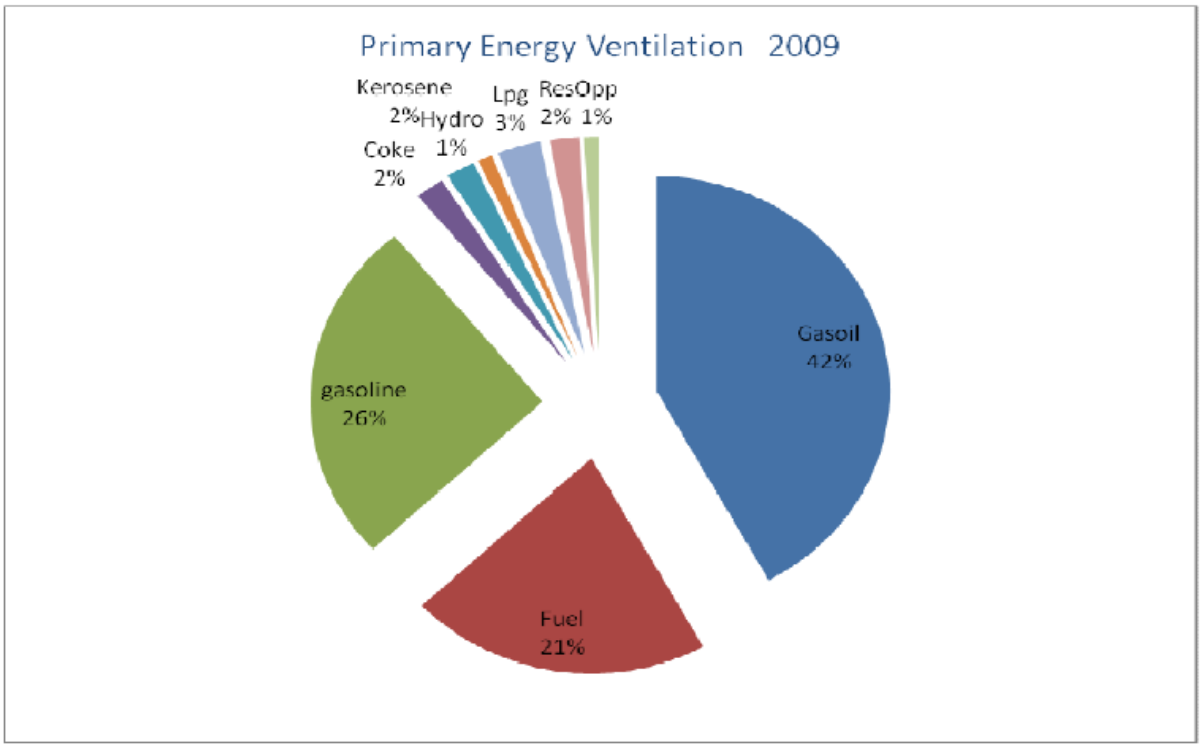


Figure 1: Repartition of primary energy in Lebanon (2009) – Source ALMEE

Renewable energies (solar, wind, biomass, micro and medium hydro-plants), despite a geographical and socio-economic context favourable to their development, remain marginal (almost 1 %) in the primary energy mix of Lebanon.

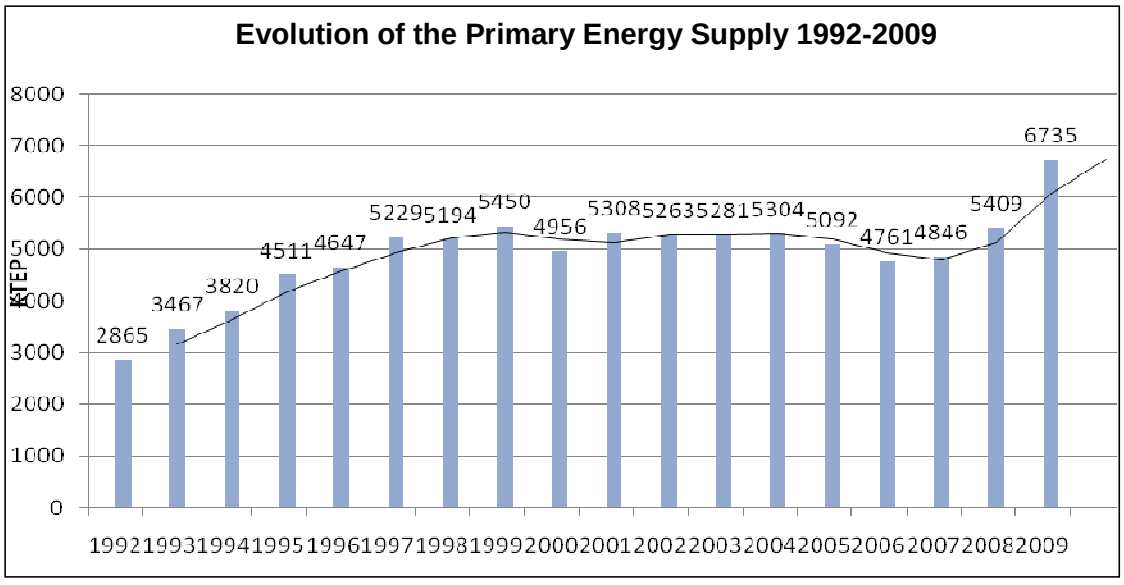


Figure 2: Evolution of primary energy total supply (1992-2009) – Source - ALMEE

The primary energy consumption per capita (1,700 kOE/cap.year) remains lower than the world average (1,900 kOE/cap.year) and represents 1/3 of that of the EU and 1/5 of that of US or Canada.

In 2009, the national energy bill reached $3,134 million, which represents more than 4 % of the GDP. It has multiplied by three since 2000 (Figure 3). In the resent years the national energy bill shows a steep increase which amounted in 8% during 2008-2009, 13.9% during 2007-2008 and 51% in the years 2005-2009. The subsidies for electricity represented 12% of the government expenditures in 2009.

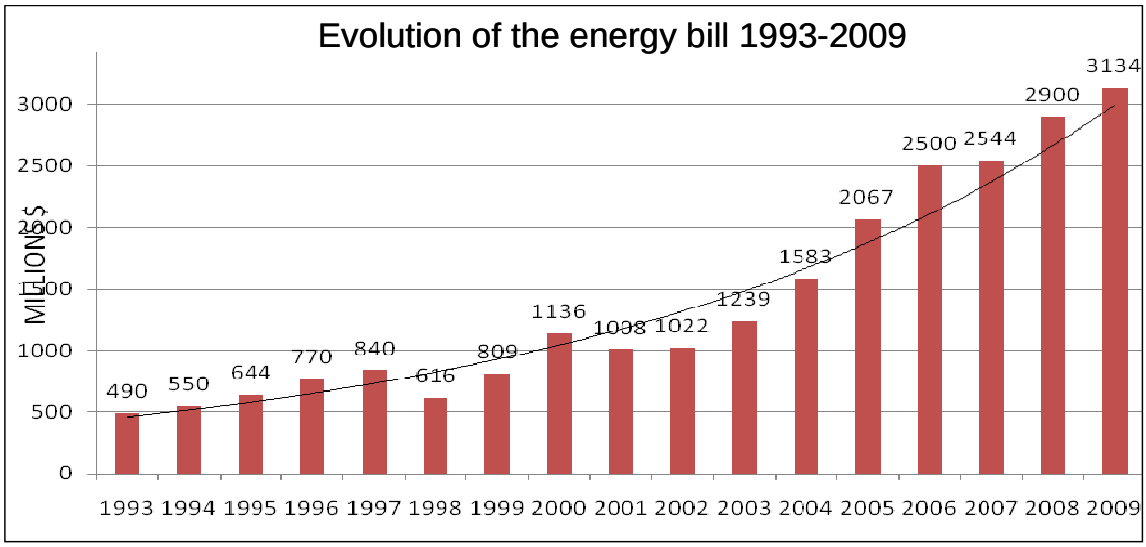


Figure 3: Evolution of energy bill 1993-2009 – Source ALMEE

This is due to the combined effects of the rise in oil prices, the growth of energy demand per capita and the demographic growth. The analysis of the final energy balance shows that the transportation sector consumes most of the energy (45%), followed by the 30% of public, residential and tertiary sector (Figure 4). Others estimations (MEDSTAT II) allow to transportation sector 40 to 42% and 33% to buildings sector. The industrial sector remains the less consuming as it is based on transformation industries with weak energy content. 25% of Lebanon's final energy consumption goes for the industrial sector.

The use of the heavy fuel-oil is limited to EDL electricity plants. The gas-oil is used, in EDL electricity plants, in industry, in heating and in the hundreds of private diesel generator sets that are dispersed all over the country to produce electricity in complement of the electricity produced by EDL. The final electricity analysis establishes that the thermal power plants' efficiencies do not go beyond 33% and that the technical losses on the high voltage and distribution networks are far from being negligible (estimated at 15 %).

In 2009, electric consumption amounted to 15,000 GWh. From the 15,000 GWh, 12,000 GWh were distributed by EDL and 3,000 by the independent generator sets (figure 5). The electric consumption represents only 18% of the final energy balance.

The hydro-power share was only 5% (figures 6 and 7), and is in continuous decline compared to the thermal production (10,188 GWh). Recurrent problems, related to demand outpacing generation as well as persistent problems at the level of power transportation and distribution, force the country to import power to a part of the North and the Bekaa from Syria and Egypt (1,116 GWh i.e. 7 % of its global consumption) through two interconnection lines 220 kV in the North and the East of the country.

The rapid increase of the electricity produced by the thermal power plants since the middle of 80s' as compared to the hydro generated electricity shows that the growing demand is always satisfied by the thermal power plants.

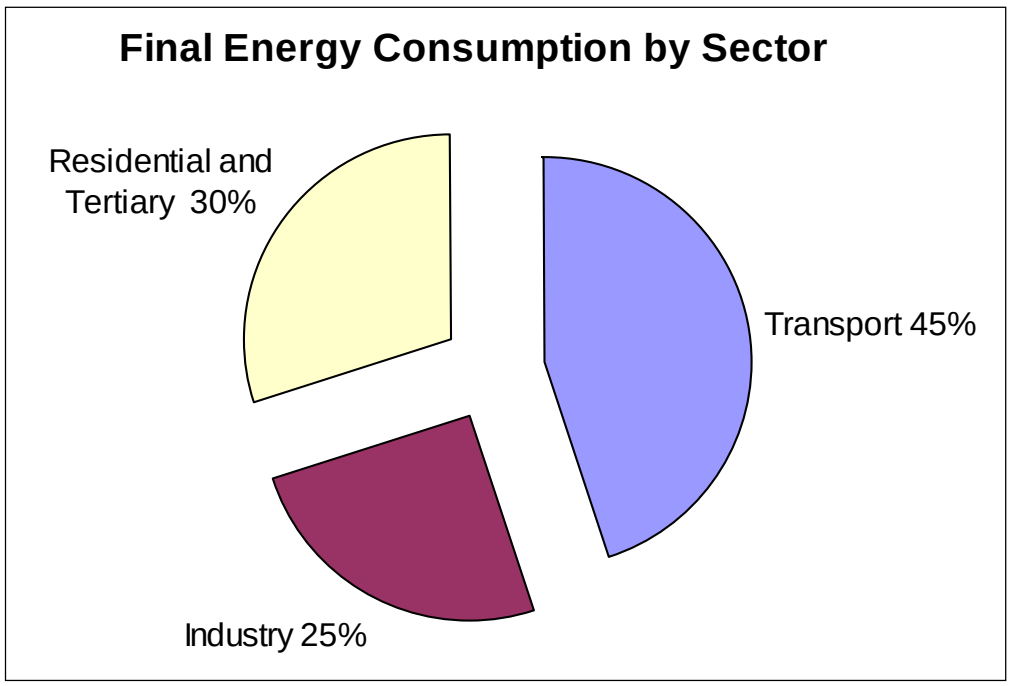


Figure 4: Repartition of end-use energy by sectors – Source ALMEE

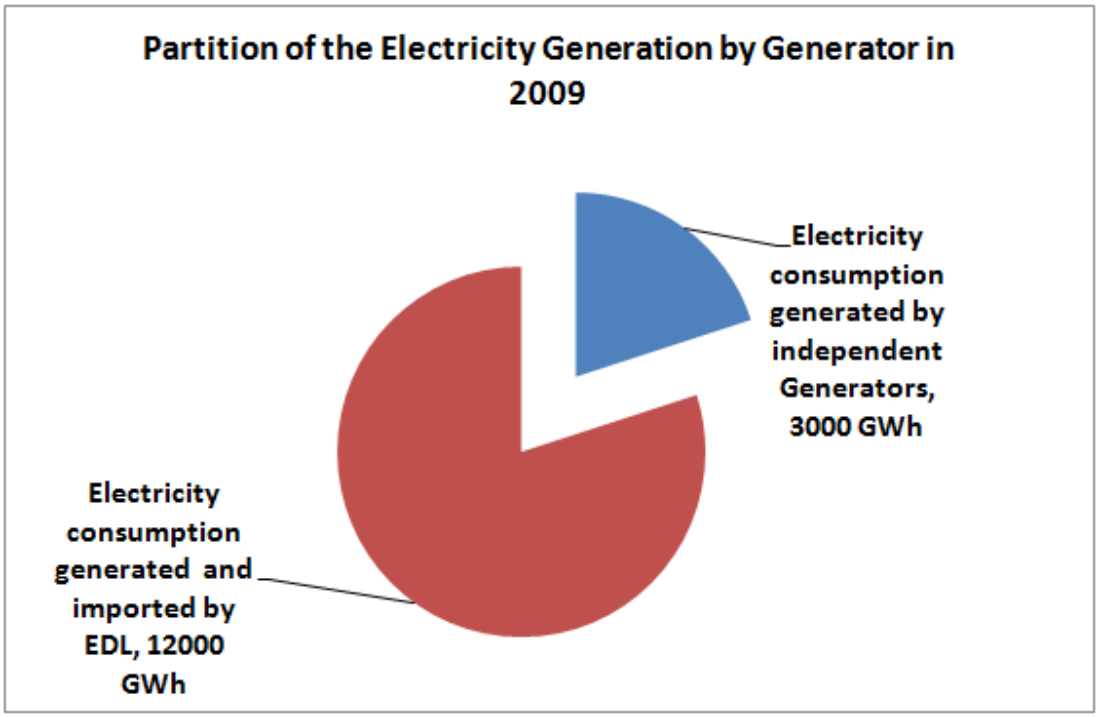


Figure 5: Electricity total consumption (2009)

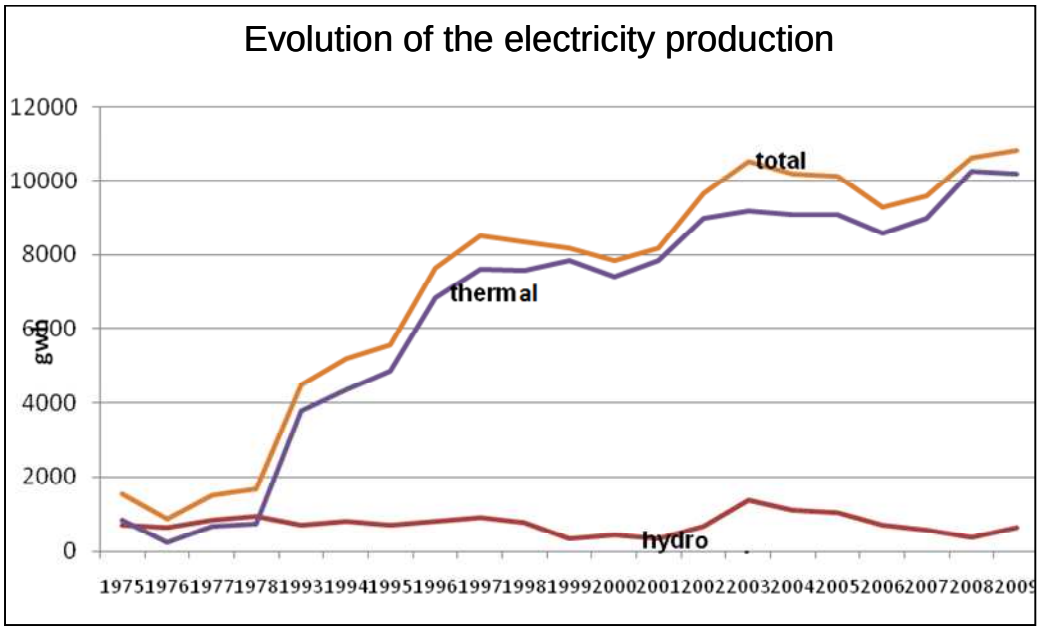


Figure 6: Evolution of electricity generated by EDL (1975-2009) – Source ALMEE

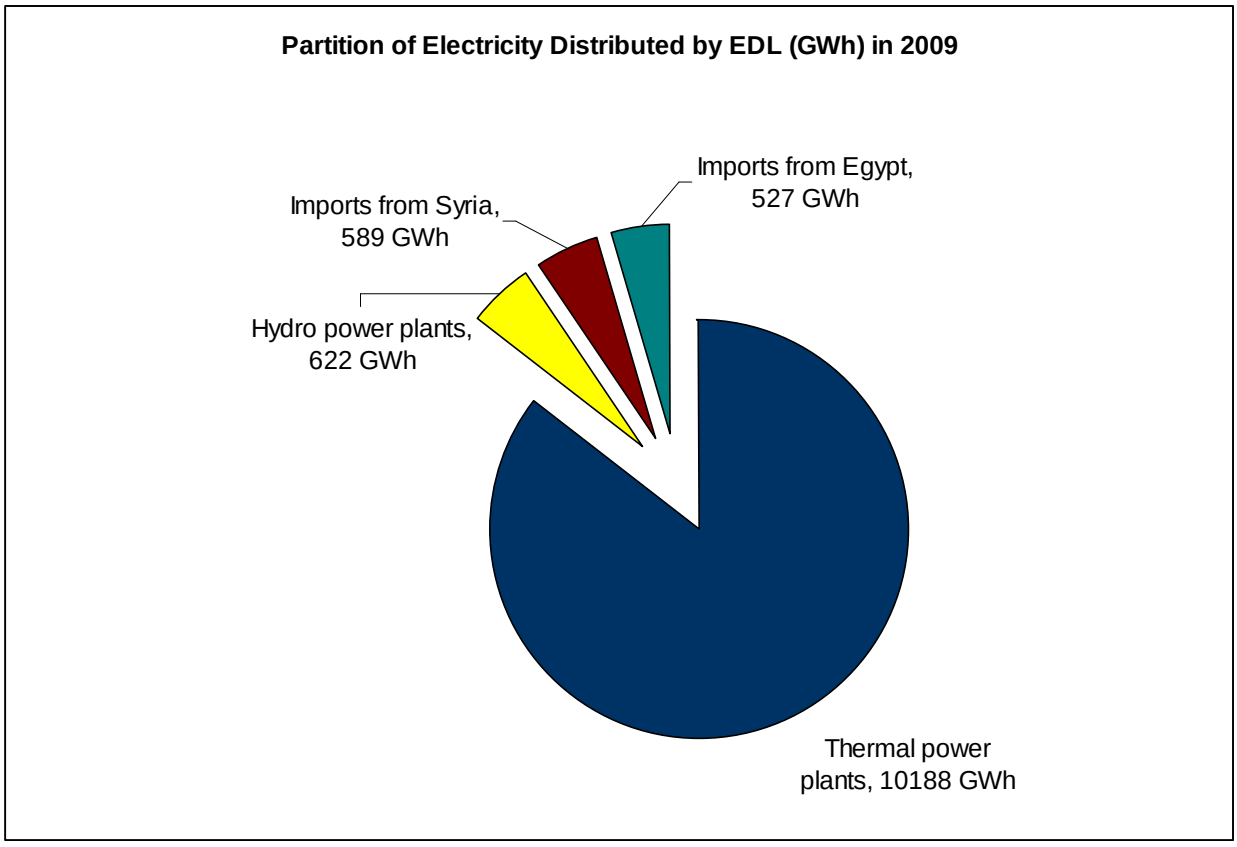


Figure 7: Repartition of electricity distributed by EDL by generation source or by import origin (2009)

The annual electricity consumption amounted, in 2009, to 3,200 kWh per capita, that is 1/3 of the consumption of the EU countries or 1/5 of that of Canada or the United States.

The rate of energy intensity of 0.25 TOE/$1,000 (figure 8) is superior to that of the developed countries (0.17 TOE/$1,000), despite the weak energy consumption per capita and industrial sector structure based on light industries with low energy use. This can be explained by consumer behaviour, the poor condition of energy-consuming industrial equipment, the transportation sector's specific structure and the lack of any policy, on the national level, of rational energy management.

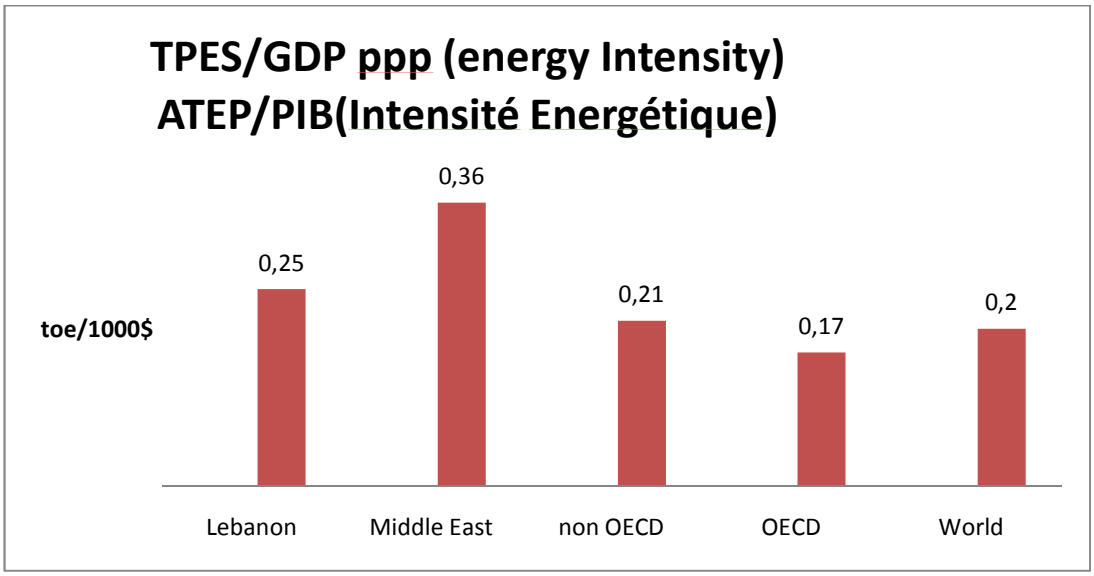


Figure 8: Energy intensity in Lebanon in comparison with world other regions – Source ALMEE

The electricity consumption of Lebanon is 0.6 kWh/$ of GDP, while in the OECD countries it is 0.33 kWh/$ of GDP and that of the world 0.46 kWh/$ of GDP. This shows that electricity is consumed inefficiently in all sectors of the economy in Lebanon.

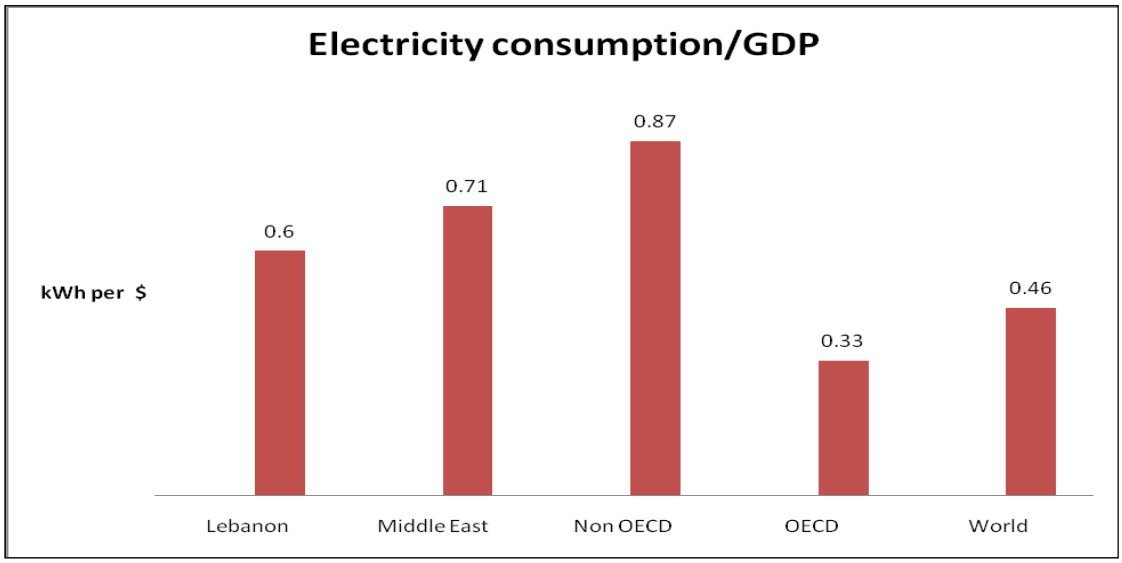


Figure 9: Electricity consumption by GDP in Lebanon in comparison with other regions – Source ALMEE

Finally, the continuous growth of the energy import bill leads to financial pressures more and more difficult to bear and which result in, among other things, frequent disruption of domestic energy market, current rationing of power supply and frequent anarchic power cuts. This constrains the Lebanese government to consider the adoption of rational energy management policies and the development of renewable energies as an alternative to the policy of trying to manage only the supply. Nevertheless, the recommended policies remain at present time in **an embryonic state**.

In this context, it should be pointed out, that the GHG generation in Lebanon is 4.74 tCO2 per capita, that is more than the world average (4.22 tCO2 per capita), double of Southern Mediterranean countries (2.43 tCO2 per capita) and less than the half of the developed countries.

Some key indicators for Lebanon follow.

Primary Energy (kTOE)	6735
RES share (including hydro) in primary energy (%)	2.6
Primary energy per capita (TOE/c)	1.7
Energy intensity (TOE/1000$)	0.25
Energy independence (%)	3
Energy bill (Million $)	3134
Thermal electric generation (GWh)	10200
Hydro-electric generation (GWh)	622
Electric power import (GWh)	1115
Independent generator sets generation (GWh)	3000
Electric power consumption per capita (kWh/c)	3200
Electric power consumption by GDP (kWh/$)	0.6
Energy sector CO_2 production (Million ton CO_2)	18.8
Carbon intensity (kg CO2/$)	0.73
CO_2 production per capita (tCO2/c)	4.74

Table 2: Energy Indicators in Lebanon 2009 – Source RESSOL-MEDBUILD

1.4. Environment level

Lebanon ratified the climate change convention in December 1994 and is a non-annex 1 party to the Kyoto Protocol; hence it has no obligations for greenhouse gas emission reductions. Lebanon has tried to initiate Clean Development Mechanism (CDM) dossiers and has 3 projects registered; the last one is for CFL (low consumption lighting).

Lebanon is the second most important emitter of GHG per capita in the region: 4 TCE (Ton Carbon Equivalent) per inhabitant in 2009. This is the double of southern and Mediterranean countries (2.43 TCE per capita).

Globally, the rate of potable water equipment is high. However, wastewater systems are insufficient at the collection and treatment level. Domestic solid waste is collected, but the operation is very expensive and the treatment system is inadequate and insufficient.

1.5. Political and institutional organisation - Stakeholders

In Lebanon, there is no institutional set-up to support renewable energy or energy efficiency.

Electricité du Liban (EDL) is in charge of the production, transportation and distribution of electricity. There are plans to privatise the sector.

The Ministry of Energy and Water (MEW) is responsible for oil, gas, the power sector and potable water and wastewater. There is no ministry for renewable energy or energy efficiency. There is **no regulatory authority** for the power sector and there is a lack of capacity in ministries.

The Technical Bureau of Lebanese cities (BTVL) was founded in 2001. It is a body of technical assistance to municipalities. It is funded by the contribution of Lebanese municipalities (55 municipalities over 900). It works to strengthen cooperation between the Lebanese cities and provides more opportunities for collaboration with other cities, especially European ones.

There are several sustainable energy experts and active NGOs in the country. Lebanese banks do have sufficient financial resources and are looking for interesting investments, but there is no experience in renewable energy and energy efficiency financing schemes.

There is no sufficient wind measurement data and solar electricity has not yet been developed. There has been some development of solar water heating (125 GWh produced in 2006).

In the country, no energy efficiency or GHG indicators are available.

The European Union has signed (24/9/2010) grant contracts with Banque du Liban (BdL) and Kafalat for the implementation of an energy efficiency financing window targeting Lebanese small and medium-sized enterprises (SMEs) that want to invest in energy savings and renewable energy technologies. This programme, which is funded with a €15 million grant, will provide investment facilities through the appropriate financial institutions, BdL with its network of commercial banks and Kafalat, in order to complement incentive systems already developed by the Lebanese State.

UNDP conducts projects in the domain of energy savings and renewable energies. Two examples are the Lebanon Cross Sectoral Energy Efficiency and Removal of barriers to ESCO

operation co-financed by the Ministry of Energy and Water and the GEF; the second is the CEDRO EE & RE demonstration project financed by the Spanish Government.

Small projects have been proposed in Lebanon in the context of the Mediterranean Solar Plan: for example one biomass project (3 MW) and two PV projects (5 MW together). The Energy Directorate of the Ministry of Energy and Water announced the preparation of a CSP project (50 MW) in the region of Hermel (Bekaa). The country is not an active participant in the MSP debate.

On Thursday, 23 September 2010, UNDP-ART GOLD Lebanon in collaboration with the Council for Development and Reconstruction (CDR) inaugurated two projects in Marjeyoun Kada: (i) The installation of a solar panel project in Meiss el Jabal public hospital, (ii) A waste disposal project in Taibeh.

In the framework of "the GEF Small Grants Programme", some small municipal projects are underway or planned: (i) Renewable Energy - Introduction and use in Arab Salim, (ii) Construction of wastewater treatment pond at the Tyre Natural Reserve, (iii) Liquid Waste Management in Nmayrie.

The Lebanon Green Building Council (LGBC) developed a new rating system (ARZ) for existing buildings with the support of IFC (World Bank). "Green Line" developed studies and training on RE. IndyAct is involving in policy actions. LSEC is active in Solar Energy Development, Etc...

"Baladiyat Programme" Empowering Municipalities through Local Economic Development (EMLED). Funded by USAID, Baladiyat's goal is to support Lebanon's rural municipalities, their private sector and community leaders in developing those skills that help grow and sustain local economic development.

ALMEE is involved in awareness campaigns in the fields of energy efficiency, renewable energy and climate change (expositions, conferences and energy audits). With the support of the IEPF (Energy Institute of Francophone Countries) ALMEE developed training workshops on energy accounting and audits for municipal staff in charge of energy (creation of an "Energy Man" in municipalities). Currently, ALMEE is conducting or participating in several EU projects: (i) "Cleanertec", production of biogas from solid waste (with the municipality of Baalbeck), (ii) RESSOL-MEDBUILD aiming to enhance research capacities in solar energy in Lebanon, (iii) "MED-INVEST" aiming to improve the energy efficiency of residential building in Lebanon. ADEME (France), with whom ALMEE has signed a cooperation agreement in the energy and environment fields, supports some small projects: a Demand Side Management (DSM) project in Zouk/Byblos (Jbeil), an educational project «Liban précieux - planète précieuse», energy efficiency in transport, development and implementation of Thermal Standard for Buildings in Lebanon, etc. ALMEE has also developed concrete projects for energy efficiency in street lighting, Photovoltaic "REMSESS", Solar Cooling "REACT" and energy efficiency in residential buildings (PEEC-FFEM project, etc.).

2. Pillars of a sustainable energy policy

2.1. Energy strategy

At the beginning of 2010, the Lebanese Government adopted an objective of gradually increasing the share of renewable energies in the supply of primary energy from 2% in 2010 to 12% in 2020 as part of its energy plan. From the other side the Strategy assumes that energy efficiency will contribute to reduce the energy consumption by 5% in comparison to base case scenario (business As usual, BAU - trend or reference) by 2020.

This policy commits to launching, supporting and reinforcing all public, private and individual initiatives to adopt the utilization of renewable energies to reach 12% of electric and thermal supply.

(Source: Policy Paper for Electricity Sector, June 2010, Page 12)

It seems that the objectives of 12% still not clear for policy makers (RE cover 12% of Primary Energy Needs or 12% of Electricity Production?) The difference is 8% of Primary energy.

This policy commits to the preparation and spreading of the culture for proper electricity use; adoption of national programs focused on demand side management as the basis for: effective energy use; peak shaving; load shifting; and demand growth control in order to save a minimum of 5% of the total demand.

(Source: Policy Paper for Electricity Sector, June 2010, Page 12)

Taking into account several factors relating to the present economic climate, reducing the primary energy consumption (car penetration rate already high, high performance of new cars) and electricity consumption (introduction of less consuming equipment), the needs for primary energy for the 2020 horizon will be **8.4 Mtoe** (including electricity generation of 22,500 GWh - i.e. 36 times the actual hydro-electricity production in 2009). Twelve per cent of primary energy is equivalent to **1,000 ktoe** to be produced from Renewable Energy.

The Council of Ministers unanimously adopted the comprehensive reform plan submitted by the Energy and Water Minister regarding the electricity sector. The "**electricity sector policy paper**" includes 10 related and comprehensive initiatives to cover the three main axes of the electricity sector, i.e. the infrastructure, sources and legal frameworks. The plan claims giving priority to the types of energy which cause the lowest damage to the environment, depending mainly on gas and renewable energy. It encompasses the setting up of liquefied natural gas (LNG) infrastructure and gas pipelines along the Lebanese coast. The plan established a legal framework for the transitional period and is aiming to create an energy sector with a **5,000 megawatt** capacity by the year 2015 (from which only new 120 MW from RE). The plan's implementation requires funding of 6 billion USD by the state, the private sector and donor nations. It would lead to lowering the energy sector's losses sustained by the state treasury, as well as the economic costs sustained by citizens and business owners who use generators to tie them over during lengthy blackouts. But in May 2011 no action plans and programmes have been undertaking to translate this strategy into effective projects.

2.2. Trends

The country has an interesting technical and financial potential capable of launching and supporting ambitious projects in the energy and environment domains. The banking sector is economically powerful with significant financial reserves and the moment could be opportune for financing energy efficiency, renewable energy and Environmental projects.

The country receives a lot of small bilateral cooperation with European countries. Lebanon positively considers the Mediterranean Solar Plan project envisaged by European partners. Lebanon presented a portfolio of 18 projects for this initiative. This indisputably reinforces the wishes to enhance cooperation with neighbouring countries on the north side of the Mediterranean Sea and, more generally, with EU member states.

2.3. Solar potential

Lebanon is geographically well situated to try with solar energy an original formula of sustainable development:

- a sunny period of 3,000 hours yearly
- a yearly average solar radiation of 2,200 kWh/m²
- a daily global sunny period of 4.8 kWh/m².

In Figure 10 the graph of the horizontal global solar radiation, from North to South and from East to West for a yearly period is presented. The slight variation of monthly averages between these zones is pointed out. On the other hand, seasonal variability remains high, with a variation factor of more than 3 between December and July. These values are related to the only available measurements in three stations in Lebanon for the period 1968-1990 (Table 3).

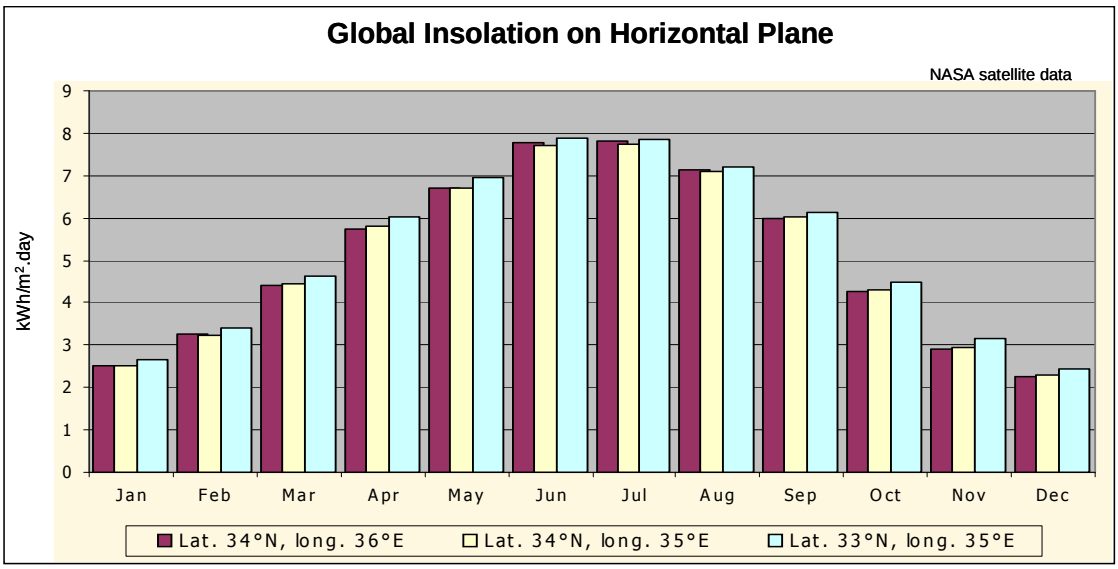


Figure 10: Average daily radiation per month in Lebanon (kWh/m².day) – Source ALMEE

It is worthwhile to point out, in this framework, that the Directorate General of the weather forecast as well as some universities are equipped with a network of meteorological stations allowing measurements of the solar radiation for hourly periods in many sites of the country. However, there is no analysis of such data.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Abde	2044	3089	3875	6095	6464	7344	7035	6822	5312	3588	2734	2115	**4715**
Ksara	2518	3625	4943	6214	7702	8840	8758	7949	6762	4849	3424	3507	**5683**
Beirut	2308	3191	4380	5496	6461	7208	7018	6424	5380	4247	3004	2317	**4793**

Table 3: Global radiation in Wh/m².day - 3 years means 1968-1990 (Source: Lebanese climatic Atlas).

Continuously renewable, without any harmful impact on the biosphere of which it is an integral part, this natural resource lends itself to many uses normally reserved for fossil fuels. Applications extend from the sanitary hot water production up to air conditioning by solar absorption chillers using a solar heating floor and a solar heat pump. These seem to be the direct applications most adapted for this renewable energy with which Lebanon is endowed. It is worthwhile to note that the medium temperature solar thermal for air conditioning or sea water desalination as well as concentrated solar power and PV are not yet developed in the country despite its potential for use in air conditioning and electricity generation.

In this context, the arguments in favour of the development in Lebanon of renewable energies seem obvious and can be summarized as follow:

- Energy bill control and balance of payments improvement.
- Reduction of the conventional energy system emissions to the local and global environment: SOx, NOx, CO2, etc…
- Reduction of the impact of future world energy pressures on national economy.
- Technical innovation promotion and technological progress dissemination, bypassing some development stages.
- Reduction of investments for expanding the conventional energy production system.
- Optimization of economic costs, favourable to a sustained growth and rapid improvement of the country incomes.
- Reduction of risks linked to uncertainties in the world energy situation.

2.4. Wind potential

The National Wind Atlas of Lebanon prepared by Garrad Hassan for the United Nations Development Program (UNDP) - CEDRO Project (25th January 2011) estimates that the effective potential installed onshore wind power capacity for Lebanon is 250 MW.

There is considerable uncertainty in all the displayed wind mapping results. Without higher quality measured data it is not possible to meaningfully define the bounds of uncertainty in the maps produced.

The wind atlas for Lebanon should be redeveloped according to international methodology and basing on effective measures of wind speed at 80m level.

2.5. The three pillars and the principle of a sustainable energy policy

Inspired from "Heliosthana" the priorities of Lebanon's new energy policy are based on three pillars:

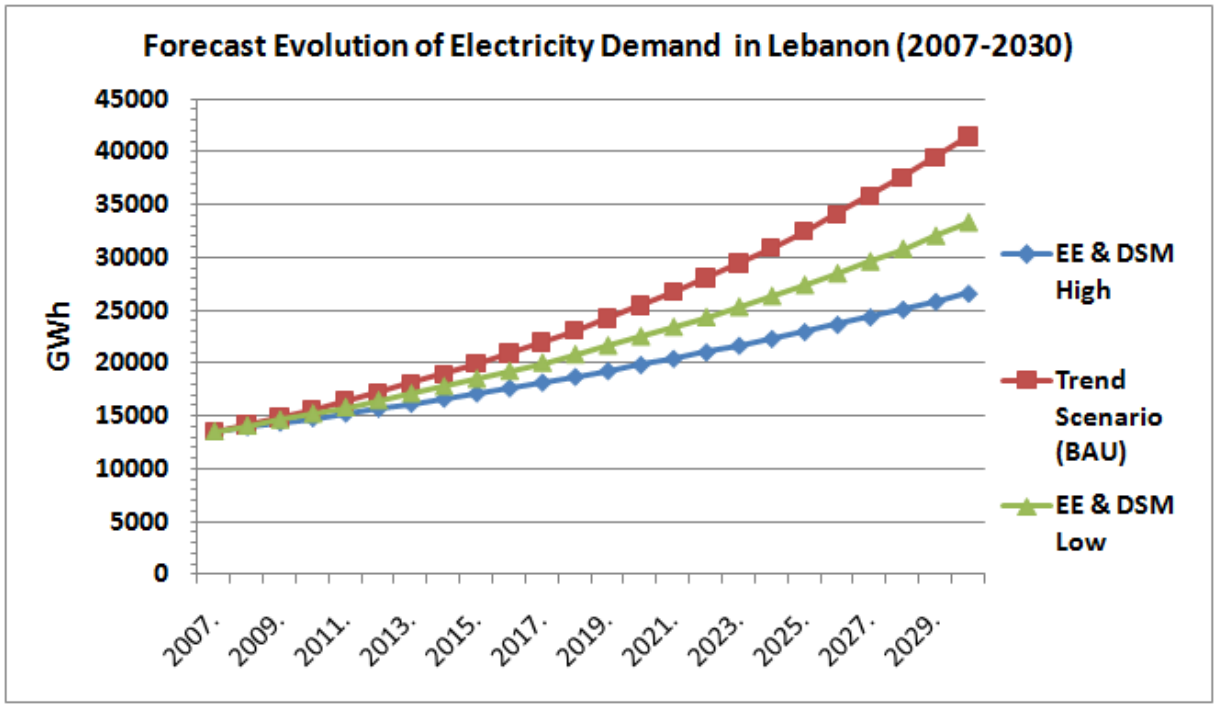
- security of energy supply;
- economic performance;
- environmental performance.

These pillars are themselves integrated and encompassed in the NegaJoule principle.

2.6. Lebanon 2020 objectives: a scenario of transition and a break with the past

- Reduction in consumption in comparison with the trend scenario (BAU) of 16% and energy intensity of 15%;
- Renewable energies cover 12% of energy needs (gross primary energy consumption) and 20% of electricity consumption (in GWh);
- Dependency on energy imports reduced from 98% to 88%;
- 28% reduction (compared with the trend scenario) in polluting emissions, in particular CO2, as a result of energy and reforestation objectives.

The impact of this strategy on the electricity demand is presented in figure 11.

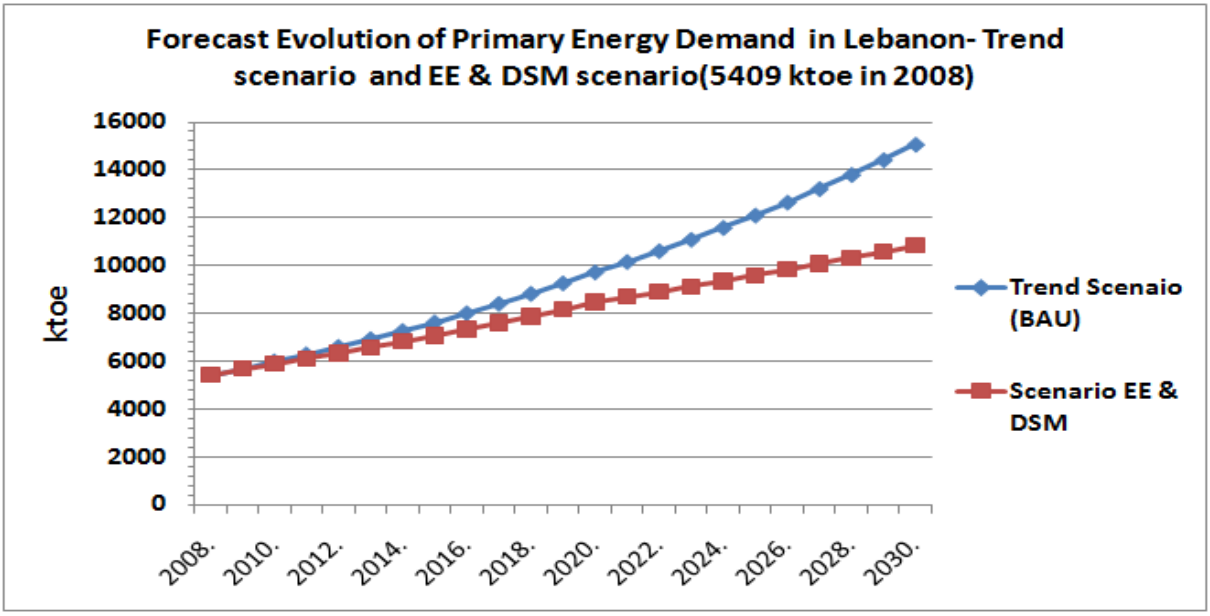


(Source : Estimation by Adel Mourtada)

Figure 11: Forecast evolution of Electricity demand in Lebanon (2007-2030)

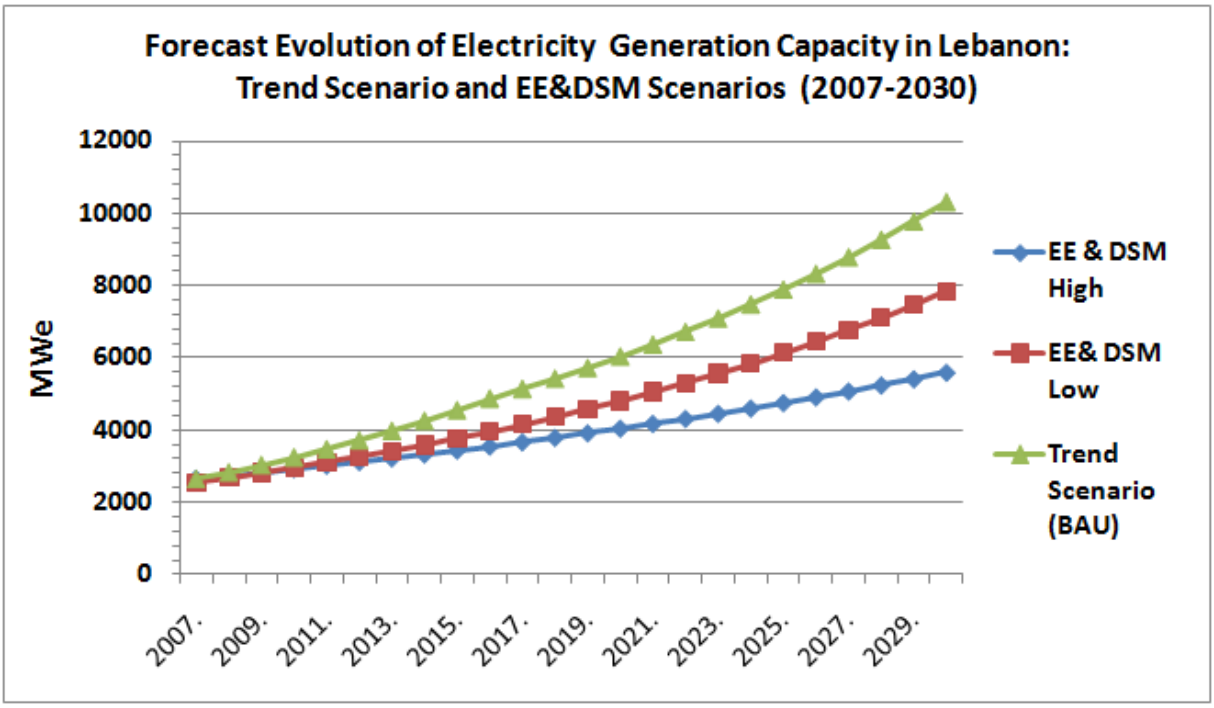
The impact of the proposed strategy on the forecast evolution of primary energy demand is presented in figure 12.

Figure 13 shows the impact of the proposed energy efficiency strategy on the electricity generation capacity.



(Source : Estimation by Adel Mourtada)

Figure 12 : Forecast evolution of Primary energy Demand in Lebanon – Trend scenario and EE&DSM scenario.



(Source : Estimation by Adel Mourtada)

Figure 13 : Forecast evolution of Electricity Generation Capacity in Lebanon – Trend scenario and EE&DSM scenarios.

2.7. Barriers to EE & RE Strategy Implementation

The analysis of the local situation revealed that the most important policy option is a to develop a clear energy Renewable Energy and Energy Efficiency strategy (based on the assessment of energy needs and the RE and EE potential) with all the stakeholders (bottom-up and top-down), then develop (or update) and enforce related laws and regulations followed by: (i) the development of suitable market based programs, (ii) creation of a favour climate for the engagement of the private sector in projects related to RE Technologies (Wind, PV, CSP, etc.) (iii) Supporting national programmes of technology transfer, education, training and research development, (iv) benefit from the European Initiatives (MSP, DESERTEC, Clean Technology Fund, Transgreen/MedGrid, etc.) and programmes of international donor agencies (MEDREG, EIB/EBRD, etc.,). The constraints facing technology transfer are divided into legislative, economic, social, technological, marketing and infrastructure.

2.7.1. Policies and Institutional Barriers

- The absence of effective policies, legislations and regulations,
- Lack of favorable import for RE&EE products and components as well as conducive policies to promote RE&EE developments;
- Limited scope for R&D institutions to interface with international bodies and to share expertise already existing within the sector;
- Private Sector is heavily constrained by regulations.

Policies and Legislations: These are the conditions that greatly affect capacity building actions for they can be the real barriers. They include regulations and standards that preclude new technologies, maintain distorting market interventions such as subsidies for polluting industries, and regulated markets that create disincentives for new technologies, planning system issues, etc.

Regulatory measures are requested to stimulate market opportunities and support the introduction of innovative methodologies, attractive schemes, investment capital, and flexible financial mechanisms.

2.7.2. Economic Barriers

- High subsidies on electricity (that make the payback period of RE applications so high for end users).
- No preference taxation for RE&EE equipment.
- RE&EE industry has no incentives to react to market demand.
- No efficient incentives to promote RE&EE investment in electricity sector: wind, CSP, PV, biogas, etc..
- Unavailability of financial mechanisms and instruments encouraging RE&EE manufacturing.
- The high cost of capital, and lack of access to capital & financial institutions (for high investments).

Immaturity of Technology: This may take several forms; the simplest is where potential purchasers are ignorant of new technology capabilities. They may also be faced with multiple and conflicting information and have limited ability/time to absorb it, and choose a known option in preference to new alternatives.

Adequacy of Resources: The transfer of new technologies requires the existence of supporting infrastructure. For example, testing laboratories, skilled labour for regular maintenance, and

availability of local manufacturing facilities to support minor modifications and spare parts are all important elements for a successful technology transfer process.

The new financial mechanisms of BDL, Kafalat and Private Banks for Green Projects need further adaptation. The amount of offered investment facilities is still very low in comparison to the expected need of capital finance.

2.7.3. Social Barriers

- Lack of Information about technologies.
- Electricity has been available cheaply - no need to explore other options.
- Lack of mainstream marketing of RE&EE options.
- Lack of priority for national R&D programs.
- Lack of training & education at university and professional or vocational level .
- Eroded consumer trust.
- Domestic expertise are not sufficiently considered.

Public Awareness: Lack of awareness is a major barrier hindering the widespread of cost-effective new technologies. Awareness about the benefits that new technologies offer as well as the provision of alternatives is very important for facilitating acceptance of new technological options. Cultural and societal barriers are also important and need to be addressed.

Capacity Buildings and awareness programmes are needed

2.7.4. Market and financial Barriers

- Most RE&EE companies are small size with limited financial capacities.
- Low competitiveness due to fossil fuels and electricity prices.
- No taxes reduction for RE&EE projects and importing.

Availability of Funding: New technologies are generally cost-intensive, and potential investors may lack the financial resources required to bear the upfront cost.

Commerciality and Competitiveness: This constitutes one of the main barriers of accelerating the technology transfer process. New technologies should be able to compete technically and cost-wise with existing and well- established products. Commerciality and competitiveness is influenced by the monopoly powers that can introduce incentives to innovate and erect barriers.

Elimination of subsidies on Electricity tariffs and fossil fuels prices – Synergy with Mediterranean projects (DESERTEC, MSP, etc.) should be developed.

3. Low consumption or how to satisfy needs without waste

The National Energy Efficiency Action Plan for Lebanon NEEAP 2010-2014 has been prepared by the NGO Lebanese Center for Energy Conservation (LCEC). The draft version has been reviewed by the third circle of experts and stakeholders on December 8, 2010- Beirut, Lebanon. And the Minister of Energy and Water announced his official adoption by the Ministry. But this NEEAP is not adequate to realise the objective of 12% RE by 2020.

Revision and adaptation of the National Energy Efficiency Action Plan (NEEAP) should be realised with clear evaluation of demand, potential cost, benefice and impacts of each initiative. Complementary measures with adapted mechanisms for implementation and relevant indicators for progress evaluation should be also designed.

We recommend strongly defining a new energy policy according to a more comprehensive Lebanon's energy strategy (see 2.1) that implies the development and implementation of wide-ranging energy management programmes based on:

- an in-depth analysis of the cultural and social context and the development of an "energy saving" culture;
- a detailed evaluation of demand based on sector and type of use (for example in buildings: lighting, heating, cooling, SWH, etc.), reduction of waste and optimal satisfaction of needs (technological and economical);
- supplying Low Consumption (LC) products, equipment, buildings, vehicles and services;
- Putting in place appropriate financing systems. These programmes should be based on sectoral energy efficiency action plans, including standards & labels (S&L), tax incentives, national ("Energy and Environment") and local energy management agencies.

National Energy Efficiency Action Plan (NEEAP)

The National Energy Efficiency Action Plan for Lebanon NEEAP 2010-2014 has been prepared by the NGO Lebanese Center for Energy Conservation (LCEC). The draft version has been reviewed by the third circle of experts and stakeholders on December 8, 2010- Beirut, Lebanon and adopted by the Ministry of Energy.

- The NEEAP is planned for the upcoming years 2011-2015.
- The proposed NEAAP is a required document that was called upon in the first point of the strategic initiative 6 of the "Policy Paper for the Electricity Sector", announced by the Ministry of Energy and Water (MEW) on July 21, 2010 (reference COM #1- 21/06/2010).
- The contents of the proposed NEEAP are in accordance with the different action steps of the MEW policy paper, specifically: 5a, 5b, 5c, 5d, 6a, 6b, 6c, 6d, 6e, 8b, and 8c.
- The proposed NEEAP is also developed in accordance with the different points mentioned in the declaration of the Lebanese Government relating to energy efficiency and renewable energy.
- The NEEAP 2011-2015 also mentions the different initiatives taking place in Lebanon, including the supporting national activities of the United Nations Development Programme (UNDP), especially through the two projects: the Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon (CEDRO) funded by the Spanish Government and the Global Solar Water Heaters Project (GSWH) funded by the Global Environment Facility (GEF).
- The current version of the NEEAP includes 14 independent but correlated activities cited bellow:

Initiative 1: Towards Banning the Import of Incandescent Lamps to Lebanon
Initiative 2: Adoption of the Energy Conservation Law and Institutionalization of the Lebanese Center for Energy Conservation (LCEC) as the National Energy Agency for Lebanon
Initiative 3: Promotion of Decentralized Power Generation by PV and Wind Applications in the Residential and Commercial Sectors
Initiative 4: Solar Water Heaters for Buildings and Institutions
Initiative 5: Design and implementation of a national strategy for efficient and economic public street lighting in Lebanon
Initiative 6: Electricity Generation from Wind Power
Initiative 7: Electricity Generation from Solar Energy
Initiative 8: Hydro Power for Electricity Generation
Initiative 9: Geothermal, Waste to Energy, and Other Technologies
Initiative 10: Building Code for Lebanon
Initiative 11: Financing Mechanisms and Incentives
Initiative 12: Awareness and Capacity Building
Initiative 13: Paving the Way for Energy Audit and ESCO Business
Initiative 14: Promotion of Energy Efficient Equipment

Table 4 below shows the potential of energy saving in buildings sector in Lebanon by EE measures – horizon 2020 and 2030.

Measure	2020	2030
Efficient shell – Heating (benefice from Thermal insulation) (in ktoe)	1344	5700
Efficient shell – Cooling (Benefice From Thermal insulation) (in ktoe)	532	1900
Dissemination of solar water-heaters (in ktoe)	499	1497
Efficient lighting (in ktoe)	803	1810
Efficient refrigerator (in ktoe)	768	2554
Other	175	557
Total (in ktoe)	**4121**	**14018**

Source estimations Adel Mourtada – PLAN BLEU.

Table 4: Energy saving potential by EE measures in Lebanon (H.2030, in ktoe)

In view of this energy saving potential, the aggregate emissions avoided over the period 2010-2030 would be in the order of 39 MTECO$_2$.

A large-scale dissemination of the priority measures will contribute to a significant reduction in the cost of these measures. The total over-cost per new housing unit would be in the range of 5 to 8% (exclusive of land cost). Energy savings would range between 40 and 60%.

The aggregate savings, subsequent to a reduction of the oil products importation bill, for the time frames 2020-2030, are given in Table 5.

Measure	2020	2030
Efficient shell – Heating (in M€)	761	3519
Efficient shell - Cooling (in M€)	301	1173
Dissemination of solar water-heaters (in M€)	283	924
Efficient lighting (in M€)	454	1117
Efficient refrigerator (in M€)	435	1577
Other	99	344
Total (in M€)	**2333**	**8654**

Source estimations Adel Mourtada – PLAN BLEU

Table 5: Aggregate savings in Lebanon, estimates in M€

The implementation at large scale of the measures recommended will lead to the creation of new business opportunities. Taking into consideration the swiftness of dissemination of the measures, the number of additional jobs generated in the case of the energy efficiency scenario may be estimated as 12000 jobs by 2020.

4. Sustainable and competitive renewable energy

Supplying sustainable and competitive renewable energy (RE) should be primordial to Lebanon's new energy policy. The following steps should be implemented to achieve this objective:

- evaluating the technico-economic potential of RE;
- analysing the constraints and solutions to overcome obstacles to the development of RE;
- developing an offering of high-quality equipment and services;
- support financing and tariff measures.

4.1. Implementation of EE & DSM Measures and Programmes

According to the electricity company's projections (trend scenario), Lebanon needed to significantly increase its total generation capacity in future years. The installed capacity of 2,350 MW (including 10% of hydropower plants) in 2010 (but only 1500 MW are operational) need to be increased to 6,000 MW in 2020 (plants relying on heavy fuel, diesel and imported gas) to meet the increased demand in the absence of a demand management policy (the most cost-efficient way of satisfying growing needs). However, a combination of increased production equipment imports and fuel imports has a very unfavorable impact on the country's investment capacity and balance of payments.

The implementation of EE&DSM measures and programmes could reduce the need of generation capacity to 4000 MW by 2020.

4.2. Feed-in tariffs and grid connection

Feed-in tariff and easy grid connection should be implemented.

A feed-in tariff (FiT, feed-in law, advanced renewable tariff or renewable energy payments) is a policy mechanism designed to encourage the adoption of renewable energy sources and to help accelerate the move toward grid parity. FiTs typically include three key provisions:

- guaranteed grid access
- long-term contracts for the electricity produced
- purchase prices that are methodologically based on the cost of renewable energy generation and tend towards grid parity[dubious – discuss].

Under a feed-in tariff, eligible renewable electricity generators (which can include homeowners and businesses) are paid a premium price for any renewable electricity they produce. Typically regional or national electric grid utilities are obligated to take the electricity and pay them.

Different tariff rates are typically set for different renewable energy technologies, linked to the cost of resource development in each case. The cost-based prices therefore enable a diversity of projects (wind, solar, etc.) to be developed while investors can obtain a reasonable return on renewable energy investments. This principle was first explained in Germany's 2000 RES Act,

The electricity grid in Lebanon should be redesigned according international standards to permit the connexion of PV systems and Wind systems.

A grid-connected PV system essentially comprises the following components: PV modules/array (multiple PV modules connected in series or parallel with mounting frame), PV array combiner/junction box (with protective equipment), direct current (DC) cabling, DC main disconnect/isolator switch, inverters, AC cabling, meter cupboard with power distribution system, supply and feed meter, and electricity connection. The integration of PV systems to electricity

networks is covered at the top level in the standard which groups the issues into two main categories: safety and power quality. DC injection and radio frequency suppression are also important topics.

4.3. Evaluation of the technico-economic potential of RE in Lebanon (2011-2020)

The potential of electricity generation from RE and the investment needs (period 2011-2020) are estimated in table 6.

Technology	Installed capacity	Share of production in Primary Energy needs in 2020 (%)	Investment needs in M€	Electricity production costs (in €cents/kWh)
Existing Hydropower	235 MW	1.54	0	3
Small sized hydropower	60 MW	0.92	86.9	4
Wind power	250 MW	1.71	235.5	6
PV plants	67 MW	0.50	193.5	24.5
CSP* (Concentred Solar Power)	600 MW	5.30	1521.7	17.3
Biogas	35 MW	0.60	76.0	5
Total	**1247 MW**	**10,57**	**2113.6**	

Source : Adel Mourtada 1 € = 1.38 US$ (February 2011)
*CSP : Concentred solar power plants without storage system

Table 6: Potential of generation electricity from RE and investments needs (2011-2020)

The potential of thermal solar water heaters and the investment needs are estimated in table 7:

Technology	Installed capacity	Share of production in Primary Energy needs in 2020 (%)	Investment needs in €
Installed solar water heaters in 2010	350 000 m²	0.44	0
New solar water heaters by 2020	1 000 000 m²	1.26	300
Total	**1 350 000 m²**	**1.70**	**216.4**

Source: RESSOL/ALMEE

Table 7: Potential of thermal solar water heaters and investments needs (2011-2020)

The potential of biomass is still not important and it is not considered in the RE plan.

The total capital investment need for RE is 2330 M€ by 2020.
The share of RE in Primary energy needs in 2020 is estimated up to 12% (electricity + thermal).
The average cost of electricity generation in Lebanon in 2009 = 13.8 €cents/kWh (excluding externalities such as pollution control costs). The cost in 2011 is estimated to be 18 €cents/kWh

5. A EuroMed model partnership

This balanced mix of energy efficiency and renewable energy projects, including decentralised and centralised, small and large scale projects will benefit the country's inhabitants and companies. To ensure the relevance of "Lebanon 2020" in an international context linked to major projects, grid connections and major project objectives should be drawn up not only for 2020, but also for 2030, 2040 and 2050 since the networks and major solar and renewable installations are planned on a long term basis.

Lebanon could share this plan with the neighbouring countries, IRENA, the MSP and DESERTEC in order to identify areas of common interest. Cooperation with neighbouring countries would facilitate the planning of the grid and electricity production. Within the framework of the MSP, some major projects were intended, at least partially, for the export of electricity via Syria and Jordan. This concerned mainly CSP plants during the day (600 MW in 2020). Best practices from neighbouring countries (example Tunisia for SWH) could help Lebanon to group together small projects, in particular those covering individual and collective SWH projects for the residential and service sectors and biomass in order to make them more interesting for large banks and investors.

The government must also carry out a prior regional strategic Environmental Impact Assessment (EIA), in order to gain a clearer understanding of the combined impact of the various projects. In practice, the government should decide to go even further and optimise the selection of sites suitable for large solar and wind power stations, while facilitating the work of industrialists, by designating Renewable Energy Development Zones (REDZ). Planning in Lebanon should take account of climate conditions (sun, wind, biomass, etc.) and the strategic EIA, including any human presence in the region, biodiversity, the fertility of the land, cooling water resources for solar thermal plants, the presence or absence of electricity grids and infrastructures, the closeness of centres of consumption, etc.

6. Sustainable urban planning and sustainable transport: "the intelligent city"

6.1. A review of urban planning law

A review of urban planning law is needed to promote sustainable development and redevelopment, encouraging and targeting proximity and synergies between residential areas, the workplace, retail outlets and leisure centres. The principles of decentralisation and densification of space include an overall quality approach favouring small to medium-sized districts and buildings. Based on a sustainable long-term vision, urban planning should be organised in consultation and should make possible the conception of a consistent overall framework and anticipate changes.

6.2. Thermal regulation and Green Building

The application of the new thermal regulation and green buildings design rules, such as the orientation of the land, have favoured passive free solar contributions as well as natural transversal ventilation and eco-construction materials, etc.. Low consumption and the integrated design approach thus facilitated the installation of a wide range of integrated RE (PV, SWH, geothermal heat pumps on a water-bearing layer) in urban areas, buildings and housing.

6.3. The role model of municipalities

Worldwide urban activity absorbs huge quantities of energy and generates important greenhouse gas emissions (GHG). In response, cities are reinforcing their efforts and implementing sustainable development initiatives linked with energy and climate policies. In Lebanon, this twin perspective (energy and climate) is quite similar and associated with sustained urban density growth during the past decades.

The European Union (EU) has decided to attribute priority status to solving these urban concerns associating energy security and the environment. An EU initiative for the stronger involvement of local authorities in encouraging energy efficiency actions as GHG emission decreases as well as environment improvements has been launched under the Covenant of Mayors (CoM). The CoM is an original initiative that commits European cities to implement sustainable energy and CO2 reduction policies.

The CoM - prepared for EU cities - is also open to non- EU Member State cities such as cities from beneficiary countries covered by the European Neighborhood Partnership Instrument (ENPI) including the Mediterranean cities in particular.

Subsequently, the Lebanese cities are invited to adhere to the CoM of Mayors and the activities could be launched for preparing the pre-accession stages with the selected cities before real involvement.

In Lebanon, urban communities and Local Authorities lack independency and proper means to react in an adapted manner and support concrete actions. Generally speaking, most cities do not have a direct access to financing and IFIs.

One of the first actions will be to establish data bases in order to define the main domains and branches that will constitute the core of the future actions of progress. Priorities must be established with the available key elements targeting the most interesting fields. The following difficulties need to be overcome:

- Local perceptions that they are not responsible for climate change, they still have low GHG emissions per capita; furthermore, the idea of having objectives similar to EU countries is not always well received.
- Energy prices (mainly electricity) are still subsidised, which does not motivate consumers: this has to be solved at the national level.
- National strategies have not been decentralised: most cities do not have a local strategy for energy and GHG reduction.

The following sectorial remarks can also be made:

- Transport and mobility policies: public transport is not sufficiently developed. LAs (Local Authorities) often have very little decision-making powers in this sector.
- Water and wastewater (collected but generally not treated): this is often a higher ranked priority than GHG reductions, but is not totally applied.
- Solid waste: solutions for waste treatment are often not part of LA decision.

It is desirable to implement an action plan within municipalities and Local Authorities, (LAs) that has for objectives:

- To support selected LAs in the implementation of energy efficient and environmental good practices and state-of-the-art technologies in urban planning (including control of application of the Thermal Regulation for buildings), policies and projects.
- To support selected LAs in the elaboration, implementation and monitoring of a sustainable Energy Action Plan (SEAP), and when possible, in joining the CoM.
- To promote and disseminate effective solutions and tools at the national and regional levels.
- To foster exchanges with EU cities.

6.5. Transport in Lebanon

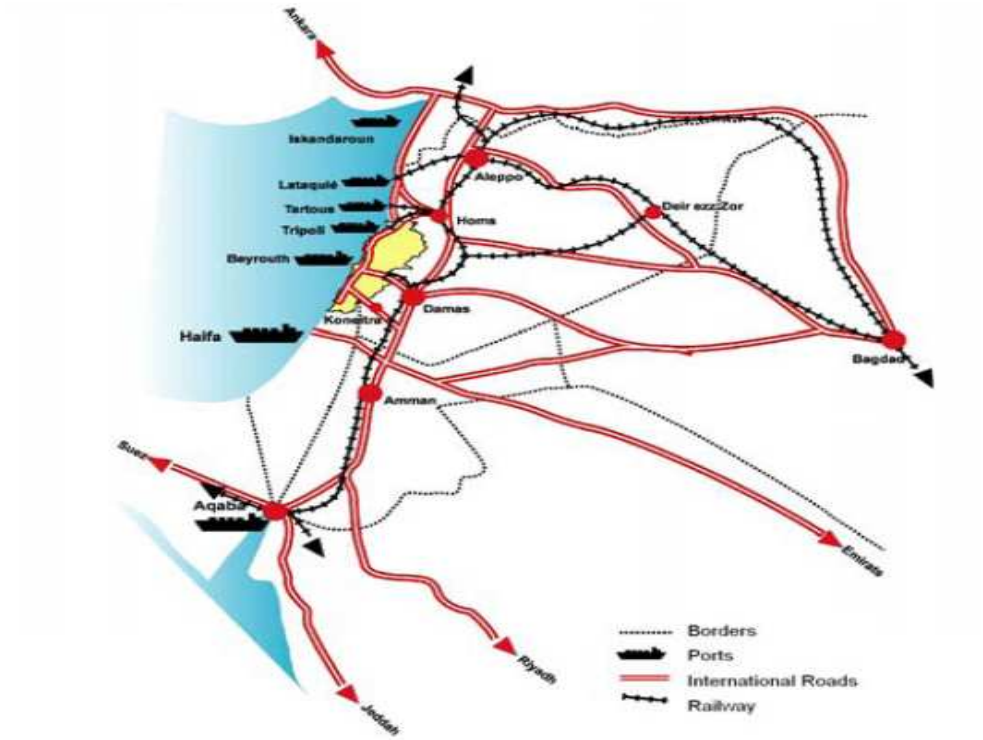


Figure 14: Transport Connection with the Middle-East (source: NPMPLT/CDR)

The sea and the air connect Lebanon with the entire world. On the other hand, its terrestrial pathways go necessarily across Syria, ever since the closure of the southern border in 1948. The railways transport mode is out of use since the 1982 (completely destroyed in 1976 and during the war of Israel against Lebanon in 1982).

6.6. Sustainable transport: interconnected networks and services to promote fluidity

The public transport in Lebanon is assured by 32625 taxis, 2000 buses (most of them for student's transportation) and around 4000 minibuses (source: Ministry of Interior) but the real number of taxis and minibuses are higher (50000 taxis and 16000 minibuses, declaration of the Minister of transportation, may 2011). The Lebanese Commuting Company (LCC) is just one of a handful brand of public transportations all over Lebanon. The publicly owned buses are managed by the (OCFTC), or the "Railway and Public Transportation Authority". From 260 buses in operation in 2000, only 20 buses still running in 2011.

Buses are popular and inexpensive and can be stopped anywhere along the way simply by hailing. But the system is inefficient the number of passengers per km is low in comparison with public transport in European countries. The percentage of daily trips per transport mode is shown in figure 15.

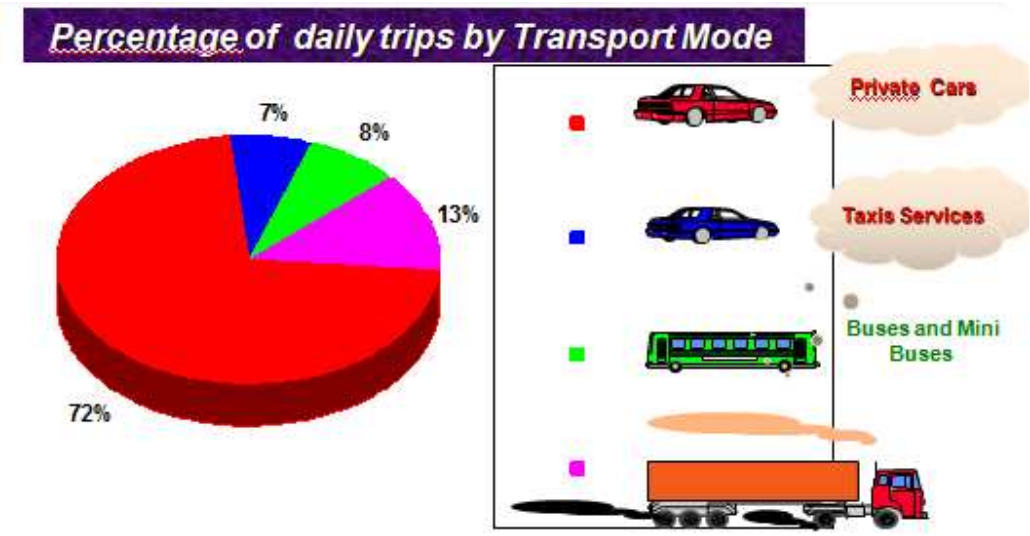


Figure 15: Percentage of daily trips by transport mode in Lebanon (source: ECOTECH)

Figure 16 shows that the number of passengers by transportation mode in Great Beirut. The private cars, the taxis services and the buses are inefficient. In order to develop and establish the credibility of a sustainable urban planning strategy, it is necessary to put in place efficient and reliable urban and extra-urban transport systems.

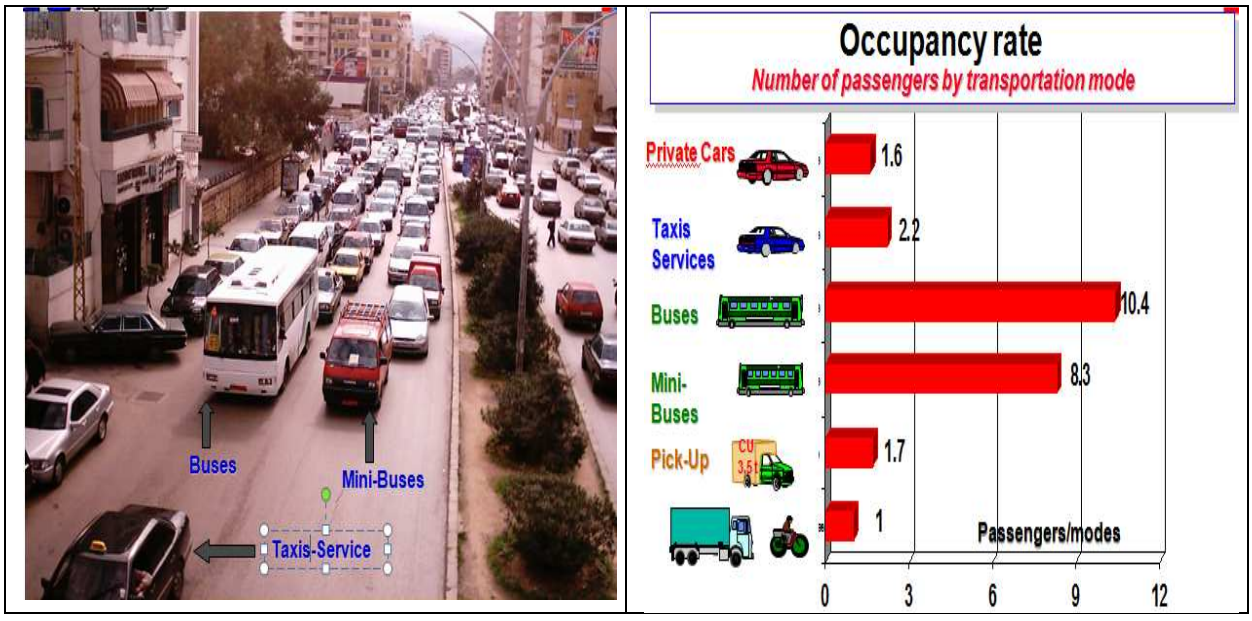


Figure 16: Number of passengers by transportation mode in Great Beirut (source: ECOTECH)

6.6.1. Urban transport

Mobility and transport plans: for each medium and large city in Lebanon, the detailed analysis of transport needs (passengers and goods) should be included in the urban transportation plan and would enable an overall, multimodal ("soft", public and individual) and adaptable mobility plan. Under this plan, public transport should have a preponderant place offering a wide choice for users as an alternative to private cars, an efficient fleet of vehicles and dedicated public transport lanes, with timetables adapted to demand. Furthermore, other additional measures should be adopted: positive incentives (fixed price multimodal transport tickets depending on the holder's personal situation and income), free travel at weekends for other people, switching to home working, the development of e-shopping combined with intelligent logistics (GPS), the LibanCarbon card and responsibility raising measures (inner city congestion charge and increased parking charges during peak hours and days, individualised mileage taxation based on satellite data). A progressive tax system based on carbon emissions (French "bonus-malus" type system) for private and company cars led people to switch to more economical vehicles (40 to 70 gCO2/km for light vehicles). The sale of vehicles exceeding 170 gCO2/km should be high taxed by 2014.

6.6.2. Modes of transport and intermodality

The public and private transport companies should promote intermodality by installing a vast network for renting traditional, folding or electric bicycles, LC or electric scooters and vehicles, including car sharing (LibanCar sharing). This network of secure bicycle garages with car parking spaces at the entrance, supplemented by car sharing networks, can offer users a wide choice of transport options in real time (including taxis) and routes provided by a system of terminals, available via a mobile phone or over the Internet.

6.6.3. The transition to sustainable transports modes

A new Lebanon's transport policy should focus on:

- the development of Public transport (future trams, trolleybuses, metro, buses and taxis. The Urban transport plan of Great Beirut developed in 1994 (aimed to promote public transport, 2 lines of metro, one light mass transport system and 19 lines of buses on reserved site) still not adopted till now.
- the use of electric and/or hybrid vehicles, biodiesel (from waste) and biogas vehicles (the diversity of fuels and sources is also a guarantee of the security of supplies as for emergency services);
- incentives (tax calculated on the vehicle's power and mileage via satellite positioning) and regulations to accelerate the transition to LC vehicles and alternative energies (electric and/or hybrid) – a standard battery exchange network should also be included among the charging options (dedicated sites, service stations),
- Eco-driving combined with a system displaying real time and annual consumption should become the norm, thereby providing an additional energy saving incentive.

6.6.4. Extra-urban transport

The government should promote rail freight (especially from Lebanon ports to Syria) to a night-time service with multimodal platforms distributing deliveries using hybrid low consumption vehicles.

The rail network should handles in 2020 most travel between cities to the frequency, quality and price of rail services (70% of the train network could be electrified, the rest could be hybrid). Passengers can complete their journey through a combination of taxis and LibanCar at a fixed-rate price.

All in all, the combination of incentives, an optimised collective transport system, eco-driving behaviour and more efficient vehicles would enable Lebanon to avoid 5 billion of km annually, i.e. 14% of total transport emissions for an energy saving of 16% compared with the trend scenario.

The response to mobility needs would enable the country to switch from an approach based on personal vehicle ownership (under-used and expensive) to a services-based approach (transportation of persons and goods based on the overall quality: time, price and impact).

6.7. Scenario well being and economic and social development

The development of EE and RE in Lebanon stipulates a scenario of well being and economic and social development: Lebanon succeeds in increasing its competitiveness in products of international concurrence (imported or exported goods) in a short period of time and in conserving an important position of its banking sector. The establishment of peace in the country and in the region greatly strengthens investors' confidence, encouraging establishment of enterprises. The institutional framework is opening the electricity sector for private producers and distributors. The electricity law 462 is under application and new law and decrees encourage the development of renewable energy. The private sector is promoting and developing renewable energy in Lebanon. Renewable is representing 12% in energy mix in Lebanon in 2020. Awareness about sustainability and Lebanon's environmental resources increases strongly. The "balanced development" concept is applied in Lebanon so that interventions would not have negative impacts on the goal of unity of the country. This concept favours the establishment of national public institution for "**Sustainable Development**" (Renewable Energy & Energy Efficiency and Environment).

KEY TRENDS: Peace in the country and in the region, a strong growing economy and Renewable energy development is promoted.

Specific characteristics of this scenario:

Economy	The Lebanese and world economic situations are good; there is private investment capital to promote renewable energy deployment in Lebanon (MSP, DESERTEC, MEDGRID, etc.)
	GDP per capita increases strongly in Lebanon from now to 2020 marked with an annual growth of 5 %.
	The doing business environment is improved through the strengthening/optimization of the regulatory framework, particularly on the level of protection of the investor. Lebanon, currently ranked at 11, goes higher among Arab countries on the Ease of Doing Business scale and encourages Foreign Direct Investments (FDI).
	Competitive sectors (including RE) are able to achieve a balance in foreign trade, where the relative shares of "other market services", like industry and agriculture, increase significantly in comparison to the present situation.
Trade	Lebanon succeeds in increasing its international competitiveness.
	Lebanon heads towards a concentration of agricultural production: notable increase in fruits and vegetables production, dairy production and

	poultry production and decrease in cereals and meat production.
	There is increased cooperation in trade in the MENA region, which results into efficient, regional solutions to promote the renewable energy technologies in the region.
Technological developments	Technological developments in Lebanon reach international levels; state of the art renewable energy are deployed in Lebanon.
	The education system gives a good place for Renewable energy. Lebanon conducts research activities in RE and becomes leader in this field in the region.
	Agricultural developments in Lebanon result into yield improvements (1.5% per year) for agricultural crops through improved agricultural practices and management techniques.
	Collection of residue streams is fully structured and replacement solutions are found for residue streams when used for bio-energy.
	Local development plans are implemented and aim at maximizing use of resources and residues through efforts to improve Lebanon's industry and agriculture value chains.
	Connection rates to the wastewater grids are improved.
Environment and land use	There is increased level of urbanization; part of the abandoned agricultural land (25%) is used for infrastructure and buildings.
	Residues are deployed for 50%, when developed in Lebanon, based on a high energy content.
Policies and regulations	There is political stability in the country and in the region
	The Lebanese government gradually restructures and increases existing tariffs to eliminate the financial deficit in the electricity sector, improve collection rates and to establish a balanced budget.
	Part of the budget will be used to decrease, Lebanon's deficits in power (new RE electricity plants) and, secondly, and to feed-in tariffs of Renewable Energy.
	Privatization of various public sectors helps to rationalize expenses in the given sectors (electricity, water, etc.) by investments complementary to those of the public sector.
	A Law is adopted for the new power plants (especially Renewable Energy) and encourages the private sector.
	Innovative financial mechanisms are put in place encouraging private sector participation.
	Standards for energy performance (buildings and appliances) are enforced.
	The development of solid wastewater treatment plans makes organic waste to become available for bio-energy production and national master plans favor the valorization of sludge (example : Baalbeck and Saida).
	Energy Efficiency is promoted.
	Energy recovery is promoted.

6.8. Partnerships in the frame of EU projects

Existing projects funded by EU in RE and EE had established a partnerships between Lebanese NGO and institutions and EU NGO and institutions. These forms of projects should be encouraged and enhanced (example: ENPI and MEDA projects).

A project titled "RESearch Elevation on Integration of SOLar Technologies into MEDiterranean BUILDings" RESSOL MEDBUILD (2010-2012) (conducted by ALMEE in collaboration with CRES – Greece, Fraunhofer ISE – Germany and NERC –Jordan) is playing an important role for raising awareness and in building researches' capacities in Solar Energy (figure 17). The recommendations of the Workshop of RESSOL project (see annex) can be adopted as part of activities in the frame of the RE strategy and master plan.

Another project aiming to increase development and use of clean energy technologies is conducted also by ALMEE in coordination with COSV (Italy) and the Municipality of Baalbeck (2011-2014). The project has objective to build a biogas digester (methane from biomass to produce energy) connected to the SWSCF (Solid Waste Sorting and Composting Facility built by OMSAR in the region of Baalbek.

ALMEE, Green Line, LSES, LGBC, etc. are active and are conducting several projects funded by EU, GEF, WB, etc. But enhancing capacities of Lebanese NGO in the field of projects' instruction is a necessity.

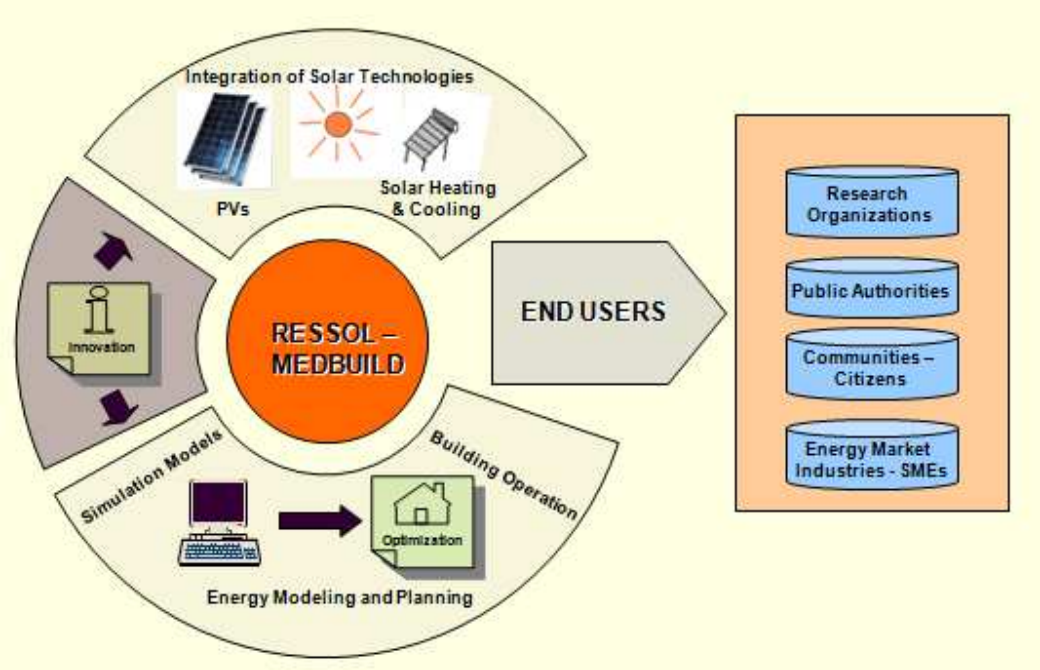


Figure 17 : Structure of the EU RESSOL-MEDBUILD project

Training in the field of projects instruction can cover:

- Information about call for standards projects (EU, etc..)
- Priorities and measures
- Eligible area
- Types of projects
- Legal framework
- Application and evaluation process
- Thematic areas
- Financial and legal aspects
- Available support

7. Conclusion

- Lebanon is very dependent on fossil energy imports. It imports about 98% of its primary energy, and most of the electricity is produced with heavy oil and diesel oil. Despite 3000 hours of sunshine per year and an average annual solar flow of 4.8 kWh/m²/day it only has 1% renewable energy, and that is mainly from hydropower.
- The power sector in Lebanon is suffering from inefficiencies and cuts.
- Electricity subsidies are a heavy burden on the public budget (17% of government expenditures in 2007). In addition, more than 20% of electricity bills are not collected.
- Growing energy consumption and growing energy prices are increasing this financial pressure.
- The electricity Law No 462 (year 2002) for the privatisation of Electricity Sector and the Establishment of a Regulation Authority still not enforced.
- At the government level there are no ministries that deal with renewable energy or energy efficiency. There is no official renewable energy or energy efficiency agency either. There are several sustainable energy experts and active NGOs in the country.
- Lebanese banks do have sufficient financial resources and are looking for interesting investments.

This International and Mediterranean context should be favourable to start a discussion on renewable energy and energy efficiency and work on increasing the share of renewable energy in the Lebanese energy mix. There are some barriers hindering the uptake:

- energy tariffs do not reflect the real cost of energy, especially electricity,
- absence of capacity at the political level and of political decisions in favour of renewable energy and energy efficiency,
- no adequate consideration of negative energy externalities,
- lack of capacity/awareness at various levels to promote sustainable energy options,
- no effective legislation,
- the new electricity plan 2010-2014 is not in line with Lebanon government target to source 12 percent of all energy needs of the country from renewable by 2020.

Activities and results:
Civil society is well organised in Lebanon, with dynamic NGOs, such as the ALMEE, LSES, LGBC, LCEC, Green Line, IndyAct, etc., and also skilled and organised professionals bodies (Order of Architects and Engineers, ASHRAE, etc.). WWF (an international NGO with high experience and skills) is wondering to work with most of them to achieve activities related to Mediterranean Solar (hot) Spot programme.

In Lebanon NGOs should:

- Act for the development of a comprehensive RE&EE Strategy.
- Focus on capacity building and awareness on RE, EE and energy subsidies.
- Work with stakeholders to develop mechanisms for RE & EE incentives and to phase out electricity subsidies.
- Work with stakeholders to review the electricity plan 2010-2014 for more RE in the electricity mix.
- Work with civil society stakeholders to campaign for a more sustainable energy mix and RE and EE targets,
- Work with stakeholders to campaign for a favourable legislative framework for RE.

Activities and results:

In Lebanon WWF should:

- Document with partners positive experiences in the world and in the region, focussing on solutions that are applicable to Lebanon.
- Use these in coordination with local NGO's to inform and capacitate Lebanese society at different levels from active civil society to more passive government officials.
- Experiment with a RE subsidy scheme in a showcase project with public and private partners.
- Document the socioeconomic and environmental impact of large expected RE projects and get feedback from civil society regarding these projects.

8. Recommendations

- Sustainable energy requires the right energy context & strong national **energy policy & reforms** and the right international support.
- Overall energy **reforms rely on** strategy, institution and regulation (balanced prices & direct subsidies) to reach economic fundamentals and social balance.
- **Focus on EE (regulation)** to limit impact of demand increase.
- **Ownership** and national & regional institution/capacity building are key (Med best practices).
- Financial support dispersed and little adapted to small and medium EE & RE projects: need for a Med EE & RE Fund.

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Annex

RESSOL-MEDBUILD PROJECT
WORKSHOP ON SOLAR ENERGY IN LEBANON: RESEARCH TRENDS
WORKSHOP'S RECOMMENDATIONS

By the end of the workshop on "Solar Energy in Lebanon" held in October 8, 2010 within the frame of the European project RESSOL-MEDBUID, the scientific committee has established the recommendations stated in this document.
Recommendations are given to encourage the establishment of fruitful activities to be done within the domain of solar energy exploitation in Lebanon and in the region. Some of the following recommendations could also be considered as a global subject for launching research works. Three categories of recommendations are given. The first one concern human resources, the second category is on technical resources and the third one is related to legislative and administrative aspects.

1- Increase Human Resources to be involved in solar energy projects:
   a. Implement short term training programs
   b. Establish educational scientific programs at all levels: technical, undergraduate and graduate
   c. Integrate within these programs the legislative and the administrative aspects related to the implementation of solar energy projects
   d. Encourage the establishment of multidisciplinary research teams

2- Improve the technical and scientific infrastructure:
   a. Generate technical and scientific guides for projects implementation in the Lebanese and the regional area.
   b. Complete the existing Solar Maps of Lebanon and the region
   c. Establish an update process for the completed solar maps
   d. Adapt when necessary the international standards related to solar energy production and distribution
   e. Study the process of technical adaptation of the electrical distribution network for future grid connectivity

3- Create a legislative support for facilitating the implementation of solar energy generation and distribution.
   a. Establishment on the national basis a legislative committee for this purpose
   b. Members of the legislative committee to be from the public and private sectors of legislation, science, industry, economy and administration
   c. Provide the appropriate scientific and technical support to the legislative committee

The following items are major necessities for making the above recommendations feasible and fruitful:
   a. Establish a cooperation between private and public sectors
   b. Benefit from the expertise of international institutions that have proved their skills through the establishment of important solar energy projects
   c. Benefit from the financial support of international programs

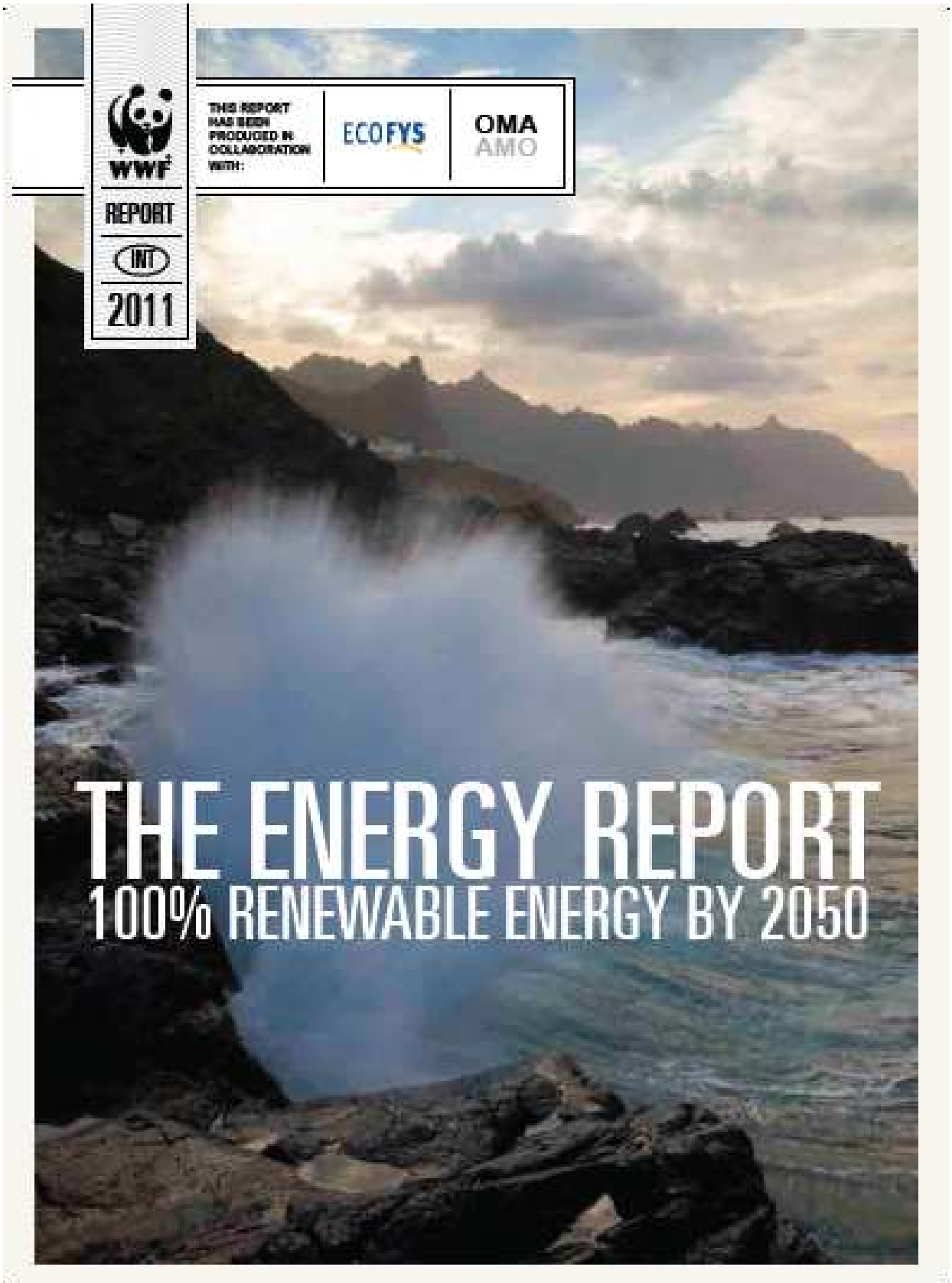
Ambitious & ample renewable electricity initiatives

World Bank CTF (Clean Technology Fund)
- Co-finance 1 GW of CSP in the MENA region over 6-8 years
- 8-10 commercial-scale power plants in multiple countries
- CTF co-financing would constitute ~ 10% of the total resources required
- Investment plan in the range of US$ 750 million

Mediterranean Solar Plan (UfM)
- 20 GW by 2020 using a mix of technologies : PV, CPV, CSP, Wind power …10 GW identified (Solar ~ 56%, wind ~ 38%, hydro ~ 6%, efficiency - ??
- 20% energy savings by 2020 compared to BAU
- Over 140 projects proposed
- Various technologies but main focus is large scale electricity generation

Transgreen / MedGrid
- Develop TransMed high-voltage lines (3.5-5 GW)
- Investment plan in the range of 40-45 bn EUR
- Partners from North & South Med: TSOs (REE, RTE), energy manufacturers (Abengoa, Alstom, Areva, Siemens) and companies (EDF, ONE)

Desertec Industrial Initiative
- Focus on Solar & Wind in MENA
- Viable business and investment plans within next three years
- Supply around 15% of Europe's electricity by 2050 (as well as producer countries needs) – EU renewables directive allows import but few concrete plans
- MoU signed by ABB, ABENGOA Solar, Cevital, Deutsche Bank, E.ON, HSH Nordbank, MAN Solar Millennium, Munich Re, M+W Zander, RWE, SCHOTT Solar, SIEMENS
- Cost estimated at 400 bn EUR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