

Energy conservation indicators in Southern Mediterranean countries



Country report for Lebanon

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Preface

The design, the implementation and the monitoring of national energy policies require relevant indicators reflecting the energy use performances at macro and sector level. Moreover, for developing countries the implementation of information systems on energy and greenhouse gas emissions indicators will be a key condition for the development of new mitigation financing mechanisms (NAMAs, sectoral mechanism, etc.) currently under negotiations for the new international climate governance regime. In fact these mechanisms will need Measures, Reporting and Verification systems (MRV) to prove the integrity of these actions. Also, for the Arab League States Energy Efficiency Directive, such indicators are crucial for the monitoring and the assessment of the National Energy Efficiency Action Plans (NEEAPs).

For these reasons and based on European experiences (ODYSSEE), PLAN BLUE, in cooperation with RCREEE and with the support of MED-ENEC, has launched the current Energy Efficiency Indicators Project in ten MENA countries, namely: Morocco, Algeria, Egypt, Lebanon, Syria, Jordan, Libya, Palestine, Tunisia and Yemen as a tenth member state of RCREEE. This project is aiming at i) strengthening the capacities of these countries in monitoring their energy policies by using the energy efficiency indicators approach ii) building and interpreting a range of basic common indicators for the region.

The project was carried out according to a two years process based on specific methodology including:

- A Participative approach associating national public and private experts
 - 4 workshops and working sessions held in Tunisia, Egypt, France and Morocco,
 - Selection, by the participants, of the common indicators to be developed in the project, based on the data availability and the relevancy for the country,
 - Technical assistance throughout the project provided by the regional coordination.
- Capacity building through “learning by doing” and experience exchanges
 - Data collection by the national experts with the support of RCREEE focal points, strengthening the cooperation between public and private experts,
 - Common development of a simplified calculation tool for data collection and indicators’ calculation used by the experts,
 - Development of capacity for analysis and interpretation of energy indicators by national experts,
 - Country reports developed by the national teams.
- Dissemination of the results and the learned lessons
 - Organization of final seminar for the decision-makers in June 2012,
 - Publication and wide dissemination of the results recorded in flyers, national and regional reports.

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List of abbreviations

CAS	Central Administration of Statistics
LCEC	Lebanese Center for Energy Conservation
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
LBP	Lebanese pound
NEEAP	National Energy Efficiency Action Plan
NEEREA	National Energy Efficiency and Renewable Energy Account
RE	Renewable energy
SWH	Solar Water Heater
TOE	Ton of Oil Equivalent
EDL	Electricité du Liban
CFL	Compact Fluorescent Lamp
EE	Energy Efficiency
GoL	Government of Lebanon
BDL	Banque du Liban / Central Bank of Lebanon
ESCO	Energy Service Company

I. Country general background

1. General context

Lebanon is located in the Middle East, bordering the Mediterranean Sea, between Syria and Palestine. The total area of Lebanon is 10,452 km² with 454 km borderline, out of which 225 km are cost line. The population is estimated as 4,100,00 with a 0.24% growth rate. The Lebanese economy is service-oriented; main growth sectors include banking and tourism. The GDP is \$39 billion and is divided per sector as follows: agriculture: 5%, industry: 16%, services: 79%.

2. Energy context - Strategies and objectives

The electricity production in Lebanon is 10,282 GWh per year. Lebanon imports 1.114 billion kWh from neighboring countries. Lebanon dependency ratio is very high (Above 95%) since electricity is either imported or produced by imported fuel with a very small fraction produced by Hydro and some renewable systems. The energy demand is higher than the produced energy and hence the power from the government is provided for 20 hours in Beirut area and up to 14 hours per day in the remaining regions of Lebanon. This led to the installation of small generators in the different regions to compensate for the deficiencies.

The LCEC and the Lebanese government have been very active supporting many initiatives to promote renewable energy strategies in the country. Some of these initiatives are listed below:

- LCEC trained local firms to conduct energy audit and supported the audit of different firms in the country. They are pushing now to make the energy audit mandatory for the commercial sector, industrial sector, public sector, and tertiary sector.
- LCEC launched a national campaign promoting the use of solar water heater. This was also adopted by the ministry of energy. From 2005 till 2010 the yearly m² solar water heaters have doubled.
- LCEC is currently developing a detailed business plan for its activities for the coming years under the NEEAP (National Energy Efficiency Action Plan). The 14 initiatives developed in the NEEAP includes:
 - Banning the Import of Incandescent Lamps
 - Adoption of the Energy Conservation Law and Institutionalization of the Lebanese Center for Energy Conservation (LCEC) as the National Energy Agency for Lebanon
 - Promotion of Decentralized Power Generation by PV and Wind Applications in the Residential and Commercial Sectors
 - Solar Water Heaters for Buildings and Institutions
 - Design and implementation of a national strategy for efficient and economic public street lighting in Lebanon
 - Electricity Generation from Wind Power
 - Electricity Generation from Solar Energy

- Hydro Power for Electricity Generation
 - Geothermal, Waste to Energy, and Other Technologies
 - Building Code for Lebanon
 - Financing Mechanisms and Incentives
 - Awareness and Capacity Building
 - Paving the Way for Energy Audit and ESCO Business
 - Promotion of Energy Efficient Equipment.
- LCEC and BDL have launched the National Energy Efficiency and Renewable Energy Account” (NEEREA). NEEREA is a flexible mechanism to fund energy efficiency and renewable energy projects from all types, all over Lebanon. This action benefits from a 12.2 M Euros grant by European Union. The slogan of NEEREA is: “Finance your energy efficiency, renewable energy, or green building project through Lebanese banks with 0% interest rate and a repayment period of 5 years”.
 - The Ministry of Energy proposed to allocate 9 Million USD to implement three initiatives in energy conservation. The Government wants “... to encourage all energy conservation measures with special focus on the development of the solar water heaters market and the energy efficient lighting ...”:
 - Subsidies on Solar Water Heaters (SWH support): (1.5 M US\$)
 - Distribution of 3 Million Compact Fluorescent Lamps (CFL project): (7 M US\$)
 - Implementation of a national plan on public street lighting (0.58 M US\$).

II. Data collection process

1. Main sources of data

Major initiations holding data and information are shown in the table below:

Institution name	Address	Tel and fax	Email and Website
The Lebanese Center for Energy Conservation. (LCEC)	Ministry of Energy and Water. - Corniche du Fleuve - First Floor, Room 303 - Beirut, Lebanon	+961-1-569 101 +961-1-565 108	http://www.lcecp.org.lb/
The Central Administration of Statistics (CAS)	Kantary Street - Beirut, Lebanon	+961-1-373169	http://www.cas.gov.lb/
Electricite Du Liban (EDL)	Mar Mekhayel Street - Beirut, Lebanon	+961-1-442720	http://www.edl.gov.lb/
International Energy Agency (IEA)	9, rue de la Fédération 75739 Paris Cedex 15 France	+33 1 40 57 65 00	http://www.iea.org/
The Lebanese Association for Energy Saving & for Environment (ALMEE)	Liban - Beyrouth - B.P. 50184	+961-1-385043	http://www.almee.org/
The Ministry of Industry	Ministry of Industry and Petroleum BLD - Sami Soleh Av. , Facing Adlieh, Badaro, - Beirut, Lebanon	+961-1-423338 +961-1-427006	http://www.industry.gov.lb/
The Ministry of Environment	Lazarieh Center, 7th & 8th Floor, Block A-4 New, A4-Old, and A5 P.O.Box: 11/2727; Beirut-Lebanon.	+961-1-976555	http://www.moe.gov.lb/

2. Data availability

Sector	Energy data			Socio-economic data			Environmental data		
	Total* number of data	Available data**		Total number of data	Available data		Total number of data	Available data	
		Number	%		Number	%		Number	%
Macro	56	56	100%	42	35	83%	7	7	100%
Transformation sector	98	84	86%						
Transport sector	49	35	71%	105	56	53%	21	7	33%
Tertiary sector	28	7	25%	35	0	0%	7	7	100%
Residential sector	21	21	100%	49	28	57%	7	7	100%
Industry sector	56	7	13%	91	0	0%	7	7	100%
Agriculture & fishing	14	0	0%	56	0	0%	0	0	
Total	322	210	65%	378	119	31%	49	35	71%

*: Total number of data expected by the sheet "Energy & socioeconomic data"

** : Total number of data (collected or estimated) filled in the sheet "Energy & socioeconomic data". One value for one year is considered as a data.

As seen in the table above, the data needed at the macro level were mainly available. The data related to the energy totals was also available. The problems in the collection were in the division of the energy data into the sectors and in the socio economic data. The environmental data was also mostly presented since they are calculated data from the energy data that are available.

3. Major difficulties met during the data collection

The major difficulties in the collection were in the lack of availability of the data and not because of a lack of cooperation. Most of the bodies, institutions and ministries provided the necessary help and provided whatever is available.

III. Indicator's calculation

1. Macro level indicators

The indicators at the macro level that were calculated from the collected data are shown in the table below:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EDR	Energy dependence Ratio	%	99%	99%	99%	98%	98%	98%	99%	99%	99%	99%
IPE	Intensity of Primary Energy	toe/1000 LBP	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
IFE	Intensity of Final Energy	toe/1000 LBP	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
RFEPE	Ratio of final energy consumption to primary energy	%	73%	73%	70%	70%	77%	72%	68%	67%	68%	67%
REB	Ratio of National Energy Bill to GDP	%	7%	6%	5%	6%	7%	9%	11%	10%	10%	9%
RPSE	Ratio of public subsidies for energy to GDP	%	7%	6%	6%	6%	7%	9%	10%	8%	12%	6%
AEF	Average emission factor	teCO2/toe	2,86	2,86	2,89	2,60	2,89	2,67	2,85	2,85	2,91	2,25
ICO2	Intensity of CO2	teCO2 / 1000 LBP	0,001	0,001	0,001	0,001	0,000	0,000	0,000	0,000	0,000	0,000
AECH	Average Primary Energy Consumption per habitant	ktoe/1000 hab	1,317	1,395	1,356	1,483	1,318	1,341	1,139	0,966	1,258	1,581
AELCH	Average Electricity Consumption per habitant	MWh/hab	2,097	2,104	2,240	2,278	2,213	2,218	2,120	2,169	2,283	3,131

The energy dependency in Lebanon is very high (>95%) because electricity is either purchased from neighboring countries or produced by purchased fuel, with a very small fraction produced by Hydro and some renewable systems. The energy demand is higher than the produced energy and hence the power from the government is provided for 20 hours in Beirut area and up to 14 hours per day in the remaining regions of Lebanon. This led to the installation of small generators in the different regions to compensate for the deficiencies. These generators are also not accounted for in the collected numbers as electricity produced since there are no statistics for them.

2. Energy transformation sector indicators

The indicators of the energy transformation sectors were calculated from the collected data and are shown in the table below:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SREC	Share of installed RE electricity capacity	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
URIC	Usage rate of the installed power generation capacity	%	38%	40%	46%	47%	46%	46%	44%	46%	54%	52%
AETS	Apparent Efficiency of Energy Transformation Sector	%	36%	36%	37%	36%	45%	39%	38%	41%	38%	29%
PGEFF	Power generation efficiency of thermal plants	%	35%	35%	35%	33%	42%	36%	36%	40%	37%	28%
SCFFP	Specific Consumption of thermal power plants	toe/GWh	245,77	245,46	243,73	256,40	201,97	233,48	236,94	214,39	225,37	304,52
PGF	Power generation efficiency	%	0,35	0,35	0,35	0,33	0,42	0,36	0,36	0,40	0,37	0,28
SCPG	Specific Consumption of Power Generation	toe/GWh	243,34	245,46	243,73	256,40	201,97	233,48	236,94	214,39	225,37	304,52
TDEE	Transmission and Distribution Electricity system Efficiency	%	81%	82%	83%	83%	83%	83%	82%	83%	84%	83%
PGEF	Power Generation Emission Factor	teCO2/GWh	757,27	763,88	758,49	797,93	628,53	726,58	737,36	667,18	701,36	947,66
ESEF	Electricity Sector Emission Factor	teCO2/GWh										

Up to the year 2011, there was no gas or oil production in Lebanon. The energy transformation is mostly from oil to electricity. The power plants in Lebanon are mainly Thermal power plants with approximately 2000 MW installed capacity (600MW in Zouk, 350MW in Jieh, 435MW in Zahrani, 435MW in Deir Amar, 70MW in Tyre, 70MW in Baalbek and 75MW in Alhreesha). The hydraulic power plants installed capacity is 220MW. The share in the RE is picking up as explained earlier in this report. The efficiency of the thermal plants is low because most of them are old plants that should be retired.

3. Industry sector indicators

The indicators of the industry sector were calculated from the collected data and are shown in the table below:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BSEC	<i>Specific energy consumption for the Cement</i>	toe/t										
	<i>Specific energy consumption for the Phosphate</i>											
	<i>Specific energy consumption for the Phosphoric acid</i>											
	<i>Specific energy consumption for the T. Super Phosphate</i>											
	<i>Specific energy consumption for the Steel</i>											
	<i>Specific energy consumption for the Paper</i>											
	<i>Specific energy consumption for the Sugar</i>											
FEIIS	Final Energy Intensity of Industry Sector	toe/Million LBP	0,175	0,221	0,171	0,203	0,191	0,184	0,097	0,071	0,095	0,078
IEBR	Ratio of Industry sector Energy Bill to Added Value	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IESR	Ratio of public subsidies to added value	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IESRGB	Ratio of public subsidies for energy to Government Budget	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IELSR	Ratio of public subsidies for electricity to added value	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IICO2	Intensity of CO2	teCO2/ 1000 LC	0,001	0,001	0,000	0,001	0,001	0,001	0,000	0,000	0,000	0,000
IAEF	Average emission factor of industry sector	teCO2/toe	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910

Small Industry has been established since 1950. The government in its rehabilitation program has been encouraging this sector by introducing new favorable laws. The Lebanese industry is mainly evolving according to the local and foreign demands of the market. Main industries are textile, china, leather, precious metals, food products, jewelry, cement, mineral and chemical products, wood and furniture products, oil refining, and metal fabricating. The Industry sector contributes 16% of the GDP and consumes approximately 20% of the final energy consumption. Although the share of the industry sector is known, the consumption per industry type is not collected anywhere and hence this was not included in the tables.

4. Tertiary sector indicators

The indicators of the tertiary sector were calculated from the collected data and are shown in the table below.

The services sector is the dominant economic sector (79% of the GDP), and heavily depends on trade, imports, exports, tourism, hotels, restaurants, & entertainment industry, but mostly on the financial industry. Lebanon has over 80 banks both local and international, serving the needs of public & private sectors via established correspondents worldwide. The country also has a large number of insurance companies both international & local. The tertiary

sector contributes 79% of the GDP and consumes approximately 5 to 10% of the final energy consumption. The same problems faced in data collection in the industry are also faced in the tertiary sector where it was not possible to get the consumption per sector (Hotel, Hospitals, etc.).

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FEITS	Final Energy Intensity of Tertiary Sector	toe/Million LBP	0,007	0,007	0,008	0,008	0,007	0,007	0,007	0,007	0,006	0,008
TDRSHR	Diffusion Rate of Solar Water Heaters in tertiary sector	m ² /1000 hab	-	-	-	-	-	-	-	-	-	-
TEBR	Ratio of energy bill to added value in tertiary sector	%	-	-	-	-	-	-	-	-	-	-
TELSR	Ratio of public subsidies for electricity to added value	%	-	-	-	-	-	-	-	-	-	-
TESRGB	Ratio of public subsidies for energy to Government Budget	%	-	-	-	-	-	-	-	-	-	-
HECNG	Energy Consumption per night guest	kgoe/Nigh Guest										
TICO2	Intensity of CO2	teCO2/ Million LBP	0,021	0,020	0,023	0,023	0,021	0,021	0,020	0,019	0,019	0,024
TAEF	Average emission factor	teCO2/toe	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910

5. Residential sector indicators

The indicators of the residential sector were calculated from the collected data and are shown in the table below:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
UCED	Unit Consumption of Energy per Dwelling	kgoe/Dw					1192,24					
SCEM ²	Specific Consumption of Energy per area unit	kgoe/m ²				10	9	8	7	6	8	13
UEICD	Unit Consumption of Electricity per Dwelling	kWh/Dw					3832,56					
SCEIM ²	Specific Consumption of Electricity per m ²	kWh/m ²				30,444	29,641	29,827	28,474	29,025	30,437	41,555
RIPE	Intensity of Residential Sector	toe/ Million LBP	0,040	0,042	0,040	0,044	0,041	0,038	0,035	0,027	0,031	0,051
RELSR	Ratio of public subsidies for energy to private consumption	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RESRGB	Ratio of public subsidies for energy to Government Budget	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RAEF	Average emission factor	teCO2/toe	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910
RICO2	Intensity of CO2	teCO2/ Million LBP	0,118	0,124	0,116	0,129	0,119	0,109	0,101	0,079	0,090	0,148
RDRSHR	Diffusion Rate of Solar Water Heaters in Residential sector	m ² /1000 hab	26,7	30,2	36,2	39,4	43,8	50,6	54,9	62,9	72,0	83,4
ERACR	Equipment Rate of Air conditioning in Residential sector	Unit/Dw					0,266					
ERFR	Equipment Rate of refrigerator in Residential sector	Unit/Dw					0,987					

The residential sector consumes approximately 25% of the final energy consumption. The residential sector is growing rapidly in Lebanon with the active real estate sector. The power needs are also increasing with the number of dwelling and because of the penetration of the air conditioning units into the market. The increase in the power needs was accomplished by small generators at very high kWh cost, since the government installed capacity did not increase since the year 2000. The government was supporting the use of solar water heaters as described in the introduction of this report. This led to the doubling (or approximately tripling) the diffusion rate of these SWH in the residential sector as seen in the table above.

6. Transport sector indicators

The indicators of the transport sector were calculated from the collected data and are shown in the table below:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
TrFEI	Final Energy Intensity	toe/Million LBP	0,053	0,047	0,046	0,047	0,044	0,044	0,042	0,030	0,041	0,044
STEHE	Share of household expenditure for transport	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
EUCC	Average Energy Unit Consumption of Cars	kgeo/car/year	1248,02	1129,92	1096,12	1138,05	1091,41	1063,72	979,73	730,95	994,19	1069,96
EUCC G	Average Energy Unit Consumption of gasoline Cars	kgeo/car/year	1248,022	1129,917	1096,121	1138,051	1091,405	1063,725	979,727	730,950	994,187	1069,840
EUCC D	Average Energy Unit Consumption of diesel Cars	kgeo/car/year										
AEFTS	Average emission factor of transport sector	teCO2/toe	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910
MR	Motorization rate	persons / Vehicle	4,49	4,41	4,35	4,30	4,18	4,11	3,99	3,85	3,61	3,37
ICO2	Intensity of CO2	teCO2/Million LBP	0,153	0,138	0,133	0,138	0,129	0,128	0,122	0,089	0,119	0,127
SCRW	Specific consumption for Rail ways	kgoe/ p.km										
SCAT	Specific consumption for air transport	kgoe/ p.km										
SCMT	Specific consumption for maritime transport	kgoe/ t.km										
SEAT	Specific emission factor for air transport	kgeCO2/p.km										
SEMT	Specific emission factor for maritime transport	kgeCO2/t.km										

The transport sector consumes approximately 42% of the final energy consumption. The number of cars in the last years has been increasing at the rate of 8% per year, which is a high rate. There is no public transportation by the government, but rather there is some private companies operating some buses on specified routes. There are no trains or trams and the infrastructure for the bus stops is also missing. This sector consumes a little less than half the energy in the country and this can be greatly improved by the introduction of a good public transportation system.

7. Agriculture and fishing sector indicator

The indicators of the agriculture sector were calculated from the collected data and are shown in the table below:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FEIA	Final Energy Intensity of agriculture	toe/ Million LBP	0,134	0,141	0,144	0,148	0,139	0,141	0,139	0,150	0,141	0,184
FEIF	Final Energy Intensity of fishing	toe/ 1000 LC										
SCF	Specific consumption for fishing	toe/ tone										
SDCA	Share of Dry cultivated area	%	81%	81%	81%	81%	80%	80%	79%	80%	80%	80%
SICA	Share of Irrigated cultivated area	%	19%	19%	19%	19%	20%	20%	21%	20%	20%	20%
SEWMP	Share of equipped wells with Moto pumps	%										
SEWEIP	Share of equipped wells with electro pumps	%										

Most agricultural activity is oriented towards fast moving consumer products. Lebanon cannot meet its consumer demands and imports many of its agricultural needs. Despite this fact Lebanon exports many of its fruits and its famed world-class wine. The main products are citrus, grapes, tomatoes, apples, vegetables, potatoes, olives, and tobacco. The agriculture sector contributes 5% of the GDP and consumes approximately 5 to 10% of the final energy consumption. This sector was the most difficult sector in data collection and we could not find data related to that sector.

IV. Conclusion

In conclusion, I would like to point that this exercise was a learning experience where many of the concepts and terminologies that we used in the last meeting and in this report were made clear. We started this workshop with different definitions and vague knowledge about the energy indicators and we ended up talking the same language.

Several data were missing for Lebanon, but this exercise made this clear and this work will constitute the basis for data collection to be continued and shared with decision makers to help them direct the country economy into a more green economy.

V. References and relevant websites

The Lebanese Center for Energy Conservation (LCEC)

<http://www.lcecp.org.lb/>

The Central Administration of Statistics (CAS)

<http://www.cas.gov.lb/>

Electricite Du Liban (EDL)

<http://www.edl.gov.lb/>

International Energy Agency

<http://www.iea.org/>

The Lebanese Association for Energy Saving & for Environment (ALMEE)

<http://www.almee.org/>

Ministry of Industry

<http://www.industry.gov.lb/>