

Energy conservation indicators in Southern Mediterranean countries



Country report for Libya

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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.

The project was coordinated by:

- Plan Bleu: Ferdinand Costes, El Habib El Andaloussi
- RCREEE: Amel Bida
- MED-ENEC: Florentine Visser
- ALCOR: Rafik Missaoui, Hassen Ben Hassine, Adel Mourtada.

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List of abbreviations

Units of measurement

GWh : Gigawatt hour

MW: MegaWatt

kg :kilogram

km kilometre

pkm: passenger-kilometre

tkm :tonne-kilometre

t :tonne

toe: tonne of oil equivalent

koe kilogram of oil equivalent

TeCO₂:

Currency and related symbols

LD: Libyan Dinar

US\$: US Dollar

Other abbreviations

GDP : Gross Domestic Product

GDP PPP : Gross Domestic Product in Purchasing Power Parity

IEA International Energy Agency

GECOL :Libya General Electric Company of Libya

REAOL: Renewable energy authority of Libya

I. Country general background

1. General context

- population: 6.46 millions
- Area: 1, 759,540 Km²
- About 90% of the population on coastal area, 60% urbanized
- Nearly all the population connected to electricity grid
- 100% of population has access to drinkable water
- Emerging country: GDP about 12,062 USD per capita (2010). high growth rate ~ 5.2% last 40 years

2. Energy context - Main challenges

Libya, a member of the Organization of Petroleum Exporting Countries (OPEC), holds the largest proven oil reserves in Africa. According to the 2011 BP Statistical Energy Survey, Libya had proved oil reserves of 46.422 billion barrels at the end of 2010, equivalent to 76.6 years of current production and 3.35 % of the world's reserves.

Oil exploration in Libya began in 1955, with the key national Petroleum Law No. 25 enacted in April of that year (a new petroleum law is currently under development). Libya's first oil fields were discovered in 1959 (at Amal and Zelten -- now known as Nasser), and oil exports began in 1961.

Libya is Africa's major oil producer and one of Europe's biggest North African oil suppliers. Supplies from North Africa to Europe destinations have the advantage of being both timely and cost effective. According to the 2011 BP Statistical Energy Survey, Libya produced an average of 1659 thousand barrels of crude oil per day in 2010, 1.97% of the world and a change of 0.4 % compared to 2009. Libya's economy is based on oil and exports contribute between 75% and 90% of State revenues.

Foreign involvement in Libya was severely reduced as a result of the sanctions and embargoes emplaced upon it, especially between the years of 1992 and 1999. Access to oil industry equipment and technology was restricted and Libya is reliant on foreign investment to keep the industry active.

Libya has very low production costs and the oilfields are close to the refineries and markets of Europe. In addition, despite almost half a century of exploration, Libya remains largely unexplored with vast oil and gas potential. The under-exploration of Libya reflects the impact of sanctions formerly imposed on the country.

According to the 2011 BP Statistical Energy Survey, Libya had 2010 proved natural gas reserves of 1.54 trillion cubic metres, 0.82% of the world and equivalent to 98 years of current production, while producing 15.8 billion cubic metres, a change of -0.6% versus 2009 and equivalent to 0.49% of the world total.

NOC controls the whole of the downstream sector together with its numerous subsidiaries and overseas arms, Umm Jawwaby Oil Services and OilInvest with its two subsidiaries of Gatoil and Tamoil.

The Umm Jawwaby Oil Services acts as the Libyan National Oil Company's procurement arm based in London. Libya is a direct producer and distributor in Italy, Germany, Switzerland and Egypt. In Italy, Tamoil Italia, which is based in Milan and has approximately 2,100 service stations, controls about 5% of the country's retail market for oil products and lubricants?

Libya currently has electric power production capacity of about 6.0-6.3 Gigawatt (GW), with peak load of around 5.76 GW. Most of Libya's existing power stations are oil-fired, though several have been converted to natural gas. Libya's power demand is growing rapidly (around 6%-8% annually). During the summer of 2004, Libya was hit by widespread blackouts as power plants could not keep up with demand. To prevent such blackouts in the future and to meet surging power consumption, Libya's state-owned General Electricity Company (GECOL) has been spend \$3.5 billion through 2010 to building eight new combined cycle and steam cycle power plants, however, construction had started at only one of the new plants, in part due to the fact that GECOL has serious financing issues due in part to low, subsidized electricity prices (around 0.02 Libyan Dinars per kilowatt-hour) and also to the fact that only 40% of Libyans pay their power bills.

The electrification of Libya reached almost 100% of the population as of the year 2005. The Libyan grid is connected to Algeria, Egypt and Tunisia, which have further connections to other networks in Turkey and Morocco with onward links to Europe. The national power utility has indicated that power links with these countries may be developed further.

3. Strategies and objectives for renewable energies

- Libya is located in the middle of North Africa with 88% of its area considered to be desert areas, the south is located in the Sahara desert where there is a high potential of solar energy and wind power which can be used to generate electricity by both solar energy conversions, photovoltaic, and thermal;
- Renewable Energy Authority Of LIBYA "REAOL" proposed national Renewable Energy plan that aims toward bringing RE into the main stream of the national energy supply system with a target contribution of 10% of the electric energy demand by the year 2020;
- Renewable energies play an insignificant role in total energy supply, the use of renewable energies to produce electricity is still at an early stage of development in Libya;
- Regarding grid-connected power plants, the focus lies currently on wind energy, and solar energy for thermal and PV systems;
- National targets published in 2010 are to reach a 10 % renewable energy share in the primary energy consumption by 2020. Expert studies state that in 2030, a 25 % share will be achieved.

II. Data collection process

1. Data collection sources

Data are collected by field from several sources:

- Energy Balance: General Electric Company of Libya and IEA
- Socio-economic data: General Information Authority of Libya.
- Other sources: National Oil Corporation of Libya, Renewable energy Authority of Libya and World Bank.

For Libya, data collection was very difficult because no available data exist; significant difficulties are encountered in specific data for end-use sectors.

The main difficulties are:

- Lack of coordination between institutions involved in data collection
- Data availability
- Incomplete annual data set
- Approximation of unavailable data

The simplified method adopted to calculate subsidies require average annual prices often complicate to calculate with good accuracy.

We collect data from the IEA and World Bank databases for energy balance and economic data

The main sources of data collection are summarized in the following table:

Institution name	Address	Tel and fax	Email and Website
General Electric Company of Libya	General Electricity Company of Libya Building Jamahiriya Area - P.O. Box 668 - Tarabulus - Tripoli - Libya	Tel: +218 21-444-5069 +218 21-444-5068 Fax:+218 21-444-7023	Email: gecol@gecol.ly http://www.gecol.ly
National Oil Corporation of Libya	Bashier Sadawi street,P.O Box 2655 - Tripoli	Tel: 00218214446181	Website : http://en.noclibya.com.ly
General Information Authority of Libya	Al-Jamhuriya St Tripoli / Libya - Tripoli. -LIBYA	Tel: 00218 213605640	
Renewable energy Authority of Libya	Zawit Aldahmani - Tripoli - Libya	Tel : (218) 34 099 97 Fax : (218) 34 068 06	

2. Data availability

The main sources of data collection are summarized in the following table:

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	80	72	90%	60	48	80%	10	9	90%
Transformation sector	140	118	84%	0	0	0%	0	0	0%
Transport sector	70	19	27%	150	19	13%	30	0	0%
Tertiary sector	30	7	23%	60	20	33%	10	0	0%
Residential sector	20	10	50%	80	9	11%	10	0	0%
Industry sector	80	9	11%	130	20	15%	10	0	0%
Agriculture & fishing	20	9	45%	80	10	13%	0	0	0%
Total	440	244	55%	560	126	23%	70	9	13%

*: 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.

Data are not available especially at the sectoral level, the lack of socioeconomic and environmental data and is significant.

The overall availability of data was 36% where a total 379 data item out of a total of 1070 were collected.

III. Major difficulties met during the data collection

In collecting the needed data, some difficulties were encountered such as:

- Lack of government statistics;
- Lack of data from private or public companies and the diffusion;
- The level of analyses that require very specific available data;
- Some indicators need great standards of analysis and they require analytical data, which many times are not available and sometimes even unreliable;
- Significant gaps in the completeness and quality of required data.

IV. Indicator's calculation

1. Macro level indicators

Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Energy dependence Ratio	%	-352%	-333%	-311%	-350%	-373%	-432%	-479%	-469%	-468%	-327%
Intensity of Primary Energy *	toe/1000 LD	1,13	1,21	1,22	1,11	1,12	0,99	0,93	0,89	0,87	0,96
Intensity of Final Energy*	toe/1000 LD	0,62	0,66	0,64	0,55	0,57	0,53	0,52	0,50	0,49	0,51
Ratio of final energy consumption to primary energy	%	55%	55%	52%	50%	51%	54%	56%	57%	57%	53%
Ratio of National Energy Bill to GDP	%	11%	10%	7%	6%	15%	15%	14%	12%	13%	0%
Ratio of public subsidies for energy to GDP	%	4%	3%	2%	2%	12%	12%	12%	10%	12%	0%
Average emission factor	teCO2/toe	3,03	2,98	2,97	2,96	2,93	2,91	2,92	2,92	2,96	0,00
Intensity of CO2	teCO2 / 1000 LC	3,430	3,617	3,627	3,281	3,276	2,883	2,714	2,589	2,583	0,000
Average Primary Energy Consumption per habitant	ktoe/1000 hab	3,078	3,114	3,058	3,133	3,272	3,157	3,108	3,117	3,161	3,512
Average Electricity Consumption per habitant	MWh/hab	1,881	1,912	2,003	2,053	2,163	3,387	3,802	3,827	3,849	3,870

*Base Year: 1995

Comments:

- Around 29% progress in energy dependence between 2000 and 2009 which shows a trend of increased consumption at the expense of production. It should be noted the impact of the oil embargo that has deprived Libya of its export potential;
- Slight improvement in primary energy intensity on average by 2.7 % per year, i.e. 21.7% of the whole variation between 2000 and 2009;
- Slight improvement in Intensity of final energy on average by 2.6% per year, i.e. 21% of the whole variation between 2000 and 2009;
- Increase of electricity consumption per habitant on average by 7.6% per year. i.e. 93% of the whole variation between 2000 and 2009.

Improving primary and final intensities is particularly due to a strong growth in GDP over the period 2000-2009. GDP without oil revenues should reflect better intensities improvements.

The strong growth in electricity demand will create serious problems to meet growing demand and heavy , but essential investments for electricity generation.

2. Energy transformation sector indicators

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%	43%	46%	50%	50%	50%	44%	53%	51%
AETS	Apparent Efficiency of Energy Transformation Sector	%	77%	78%	76%	75%	76%	73%	72%	72%	70%	#DIV/0!
PGEFF	Power generation efficiency of thermal plants	%	25%	26%	27%	26%	29%	28%	28%	29%	28%	28%
SCFFP	Specific Consumption of thermal power plants	toe/GWh	339,96	331,95	322,34	326,82	298,09	309,85	306,27	296,92	309,31	303,45
PGF	Power generation efficiency	%	0,25	0,26	0,27	0,26	0,29	0,28	0,28	0,29	0,28	0,28
SCPG	Specific Consumption of Power Generation	toe/GWh	339,96	331,95	322,34	326,82	298,09	309,85	306,27	296,92	309,31	303,45
TDEE	Transmission and Distribution Electricity system Efficiency	%	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,00

Comments:

- Lack of renewable energy electricity market penetration;
- Significant increase of usage rate of the installed power generation capacity;
- Low reduction in specific consumption of power generation with 11 % of efficiency gain.

The transformation sector has some features:

- Low efficiency, this is particularly due to the effects of the oil embargo on the maintenance and management of transformation plants;
- High specific fuel consumption despite a significant decrease between 2000 and 2009;

An improvement of the sector indicators would have a significant impact on energy supply and demand.

3. Industry sector indicators

Libyan industrial development has been heavily dependent on the oil sector, both for investment revenue and for raw inputs.

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FEIS	Final Energy Intensity of Industry Sector	toe/1000 LD	0,360	0,375	0,368	0,420	0,350	0,406	0,457	0,436	0,161	

Since the early 1960s, the petroleum industry has increasingly dominated the whole economy. The development of the oil industry was remarkable, both in terms of its rapidity and its proliferation. An exceptional combination of circumstances contributed to the development of the petroleum sector industry, including the exploration, production, transport, and marketing of petroleum products (crude petroleum, natural gas, and condensates derived therefrom),

contributed at over the half of GDP (at factor cost) and virtually 100 percent of exports. Industrial activities also occupied more than 30 percent of the total labor force.

Industry sector data are unavailable and there are few industrial branches excluding mining and hydrocarbon industries.

The dramatic decline in intensity in 2008 is mainly due to soaring of oil prices and a decrease in energy consumption in the same year.

4. Tertiary sector indicators

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FEITS	Final Energy Intensity of Tertiary Sector	toe/1000 LC	-	-	0,032	0,015	0,017	0,031	0,035	0,029	0,041	-

National economy structure of Libya is characterized by:

- Low Share of services in the GDP;
- Low tertarization of the economy.

The Libyan economy has suffered from over 2 decades of sanctions. Additionally, exclusion of the private sector from major economic activities has limited the growth and diversification of the economic sectors, finally tertiary sector is also little covered by statistics and surveys which does not allow an exhaustive analysis.

5. Residential sector indicators

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
UCED	Unit Consumption of Energy per Dwelling	kgoe/Dw	1879,25	1576,98	1596,46	1596,14	1639,76	1846,22	1926,43	1855,34	1854,62	1861,70
SCEM ²	Specific Consumption of Energy per area unit	kgoe/m ²	16	13	13	13	14	15	16	15	15	16
UEICD	Unit Consumption of Electricity per Dwelling	kWh/Dw	4345,99	4290,21	4235,16	4234,33	4537,89	7894,80	8893,29	7765,01	5679,26	6756,71
SCEIM ²	Specific Consumption of Electricity per m ²	kWh/m ²	36,217	35,752	35,293	35,286	37,816	65,790	74,111	64,708	47,327	56,306
RIPE	Intensity of Residential Sector	toe/ 1000 LYD	0,240	0,188	0,172	0,225	0,203	0,231	0,417	0,336	0,355	0,323

Comments:

- Stable energy consumption in household sector despite a significant increase in electricity consumption;
- High increase in electricity consumption per dwelling on average by 5 % per year, i.e. 55% of the whole variation between 2000 and 2009;
- Significant increase in Final Energy Intensity on average by 3% per year, i.e. 35 % of the whole variation between 2000 and 2009;

This indicators highlight:

- The impact of increasing comfort demand and the size of dwellings;
- Buildings are using more energy, as more appliances are installed;
- Despite a constant level of Household's energy consumption, the consumption of electricity is growing. This is due particularly to fuel switch in household energy consumption;
- Electricity Prices largely subsidized.

The implementation of an energy efficiency policy with an institutional and regulatory framework is essential to reversing the trend.

6. Transport sector indicators

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
TrFEI	Final Energy Intensity of transport sector	toe/1000 LYD	0,249	0,222	0,230	0,210	0,193	0,178	0,174	0,170	0,178	0,188
EUCC	Average Energy Unit Consumption of Cars	kgeo/car/year	8507,54	6297,89	4226,99	3865,47	3582,24	3279,27	2873,81	2457,16	2235,44	0,00
MR	Motorization rate	persons / Vehicle	12,78	9,42	7,50	6,72	6,09	5,88	5,13	4,26	3,78	3,41

Calculated indicators highlight:

- Lack of data to analyse transport sector and subsectors (Maritime, air and rail transport);
- Important share of transport sector in total final energy consumption;
- High increase of motorization rate;
- Low impact of transport policy to encourage people to use cars less and other mode more;
- Low share of public transport in all transport modes;
- Largely subsidizes fuel prices.

Energy saving program aims to further promote public transport, upgrade domestic lines and strengthen transport by bus. This approach takes into consideration the requirements of sustainable development in the transport sector by ensuring an easy flow of traffic in major cities, reducing pollution and adopting energy saving programs. Reinforcement of railway transport is one of the major axes of the sector's development strategy.

7. Agriculture and fishing sector indicator

Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Final Energy Intensity of agriculture	toe/ 1000 LYD	0,131	0,134	0,124	0,173	0,224	0,541	0,525	0,543	0,531	0,527

Libya is deeply dependent on imports for domestic food demand. Climatic conditions and poor soils limit farm domestic food production. Domestic conditions limit output, while income and population growth have increased food consumption. Compared to its North African neighbours, the agriculture sector contribution to the country's Gross Domestic Product (GDP) in Libya is a lot lower and has been declining ever since oil discovery in 1958. With increasing oil revenues, the share of non oil related industries remained small.

The agriculture sector is quite difficult to analyze and few data on energy consumption are available. The contribution of the sector in the GDP is less and less important. Many information and surveys are needed to identify trends and adapted policy.

V. Conclusion

Main comments on the overall exercise, learned lessons

- The project is an instructive and upgradeable exercise;
- Right approach with strong involvement of local expert;
- Excellent teamwork with instructive comparisons;
- Global view on use, determinants and interpretation of indicators;
- Good technical and human experience.

Perspectives

- Set up a large indicator sets covering most sustainable development issues and providing detailed insights;
- For decision-making purposes, less complex frameworks with small sets of a few lead indicators;
- The list of energy indicators in use is inexhaustible, e.g.. The question arises, which energy indicators are strongly linked to one or the other important sustainability topic and should be used within the small set of lead indicators;
- Improve Data collection from the surveys include information on monetary expenditures and physical quantities, including fuels and electricity, as well as information of other socio-economic, demographic, and infrastructural data.

VI. References and relevant websites

Nation's accounts: Central Bank of Libya

Financial statistics bulletin: Central Bank of Libya

Annual Reports:

General Electric Company of Libya,

General Information Authority of Libya

National Oil Corporation of Libya,

Renewable energy Authority of Libya.