1- Introduction

Lebanon covers an area of 10 452 km^2, and consists of a narrow coastal strip of land adjacent to the Mediterranean Sea, more than 100 km long. Lebanon has a population of about 4 million people, 70 per cent of whom live in urban areas. Lebanon has a democratic regime with an open liberal economic system. Import and export is totally free. GDP for the year 2004 is estimated to be 21400 million USD with 1.5% annual growth rate. The main industry comprises cement plants.

Lebanon

area : 10 452 km² Population : 4 millions
Density : 382 hab./km² Aliens : about 700000
Active Population: 1625000 Unemployment : est. 20%
Capital: Beirut (1,5 million hab.)
Main cities : Tripoli (200000), Saïda (100000), Tyr (70000), Zahlé (30000)

Lebanon is a parliamentary republic, independent since 1944.
The president of the republic, General Emile Lahoud, was elected October 1998 for a 6 year mandate and renewed for 3 more extra years.
The prime minister M. Rafic Hariri, who took his functions in October 2000 was assassinated in February 2005. The actual prime minister is Fouad Sanyoura
The president of chamber of deputes M. Nabih Berry, was elected for 4 years in 2005.

Lebanon is located on the eastern coast of the Mediterranean Sea in the Middle East. The country can be divided into four topographical regions (figure 2) :

(1.) The coastal plain that becomes a narrow strip in the north.
(2.) The coastal mountain range or Lebanon Mountains that are a series of crests and ridges.
(3.) The Central Plateau that consists of the Syrian Plain and part of the Bekaa valley.
(4.) The eastern mountain range which comprises the remainder of the Bekaa Valley and rises to form the Jabal ash Sharqi or Anti-Lebanon Mountains as well as the Jabal ash Sheikh or Mt. Harmon, which forms the eastern border with Syria.

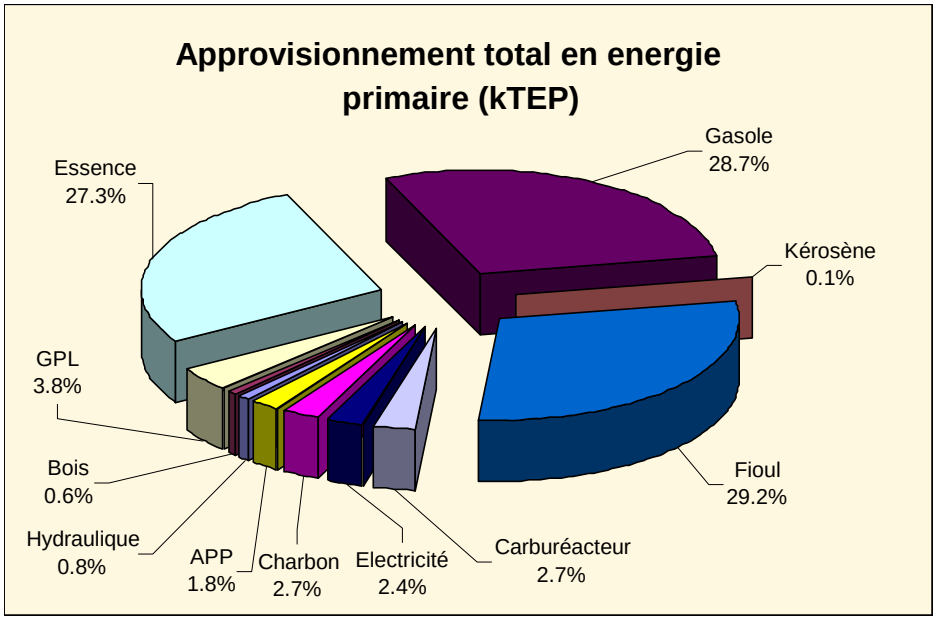
The comparison of the average temperature in August and July for different locations in Lebanon shows that August is the hottest month in Lebanon. January is the coldest month in Lebanon.
The climate is Mediterranean, with the temperature in the capital Beirut ranging from 5°C in winter

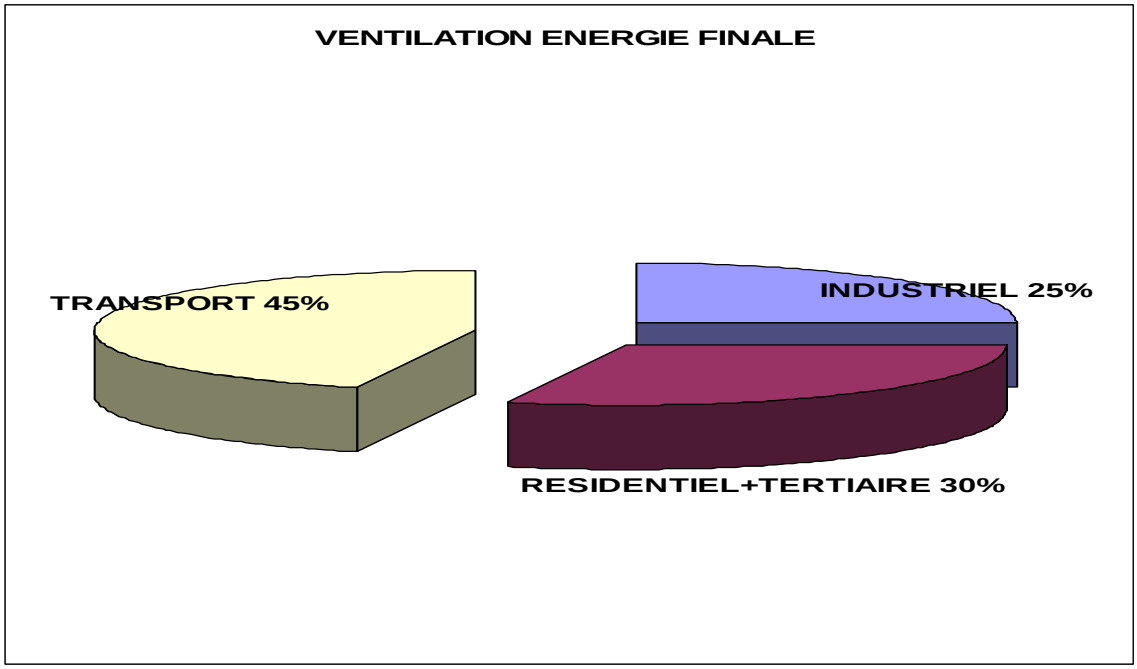
up to 32°C in summer.
The average annual precipitation in Lebanon is 830 mm, falling during only four months of the year.

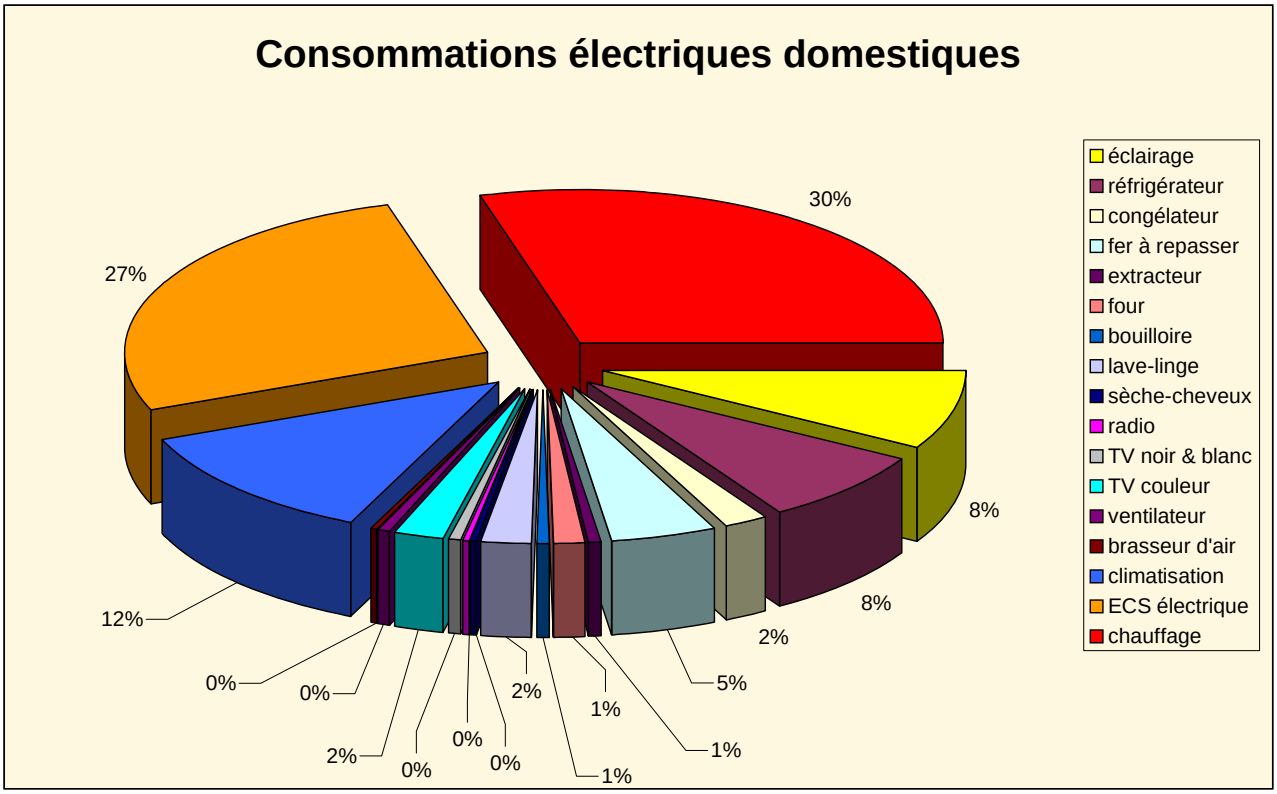
Some of 6000-km2 lands are under irrigation, with about 90 per cent of national food production dependent on irrigation.

Lebanon is not an oil or coal producer and the energy consumed is totally based on imported oil derivatives. Use of any form of Renewable Energy (RE) is very limited in Lebanon. 25% of Lebanon's final energy consumption goes for the industrial sector, 30% goes for the residential, public and commercial sectors, and the remaining 45% goes for the transport sector.

The energy sector in Lebanon is in a continuous deficit since 99% of its primary energy needs is imported and based essentially on oil derivatives.Since the end of the civil war, the national energy bill has been increasing regularly: it went up 250% from 1992 till 2000.




VENTILATION ENERGIE FINALE
TRANSPORT 45%
INDUSTRIEL 25%
RESIDENTIEL+TERTIAIRE 30%



The solar market

As it is the case in all Mediterranean Southern countries, , the solar market opportunities are important and regular and extremely favorable to the use of the solar energy for all thermal applications:

- Number of hours of sunshine: approx. 3000 hours/year
- Yearly average radiation: 4,8 kWh / m²

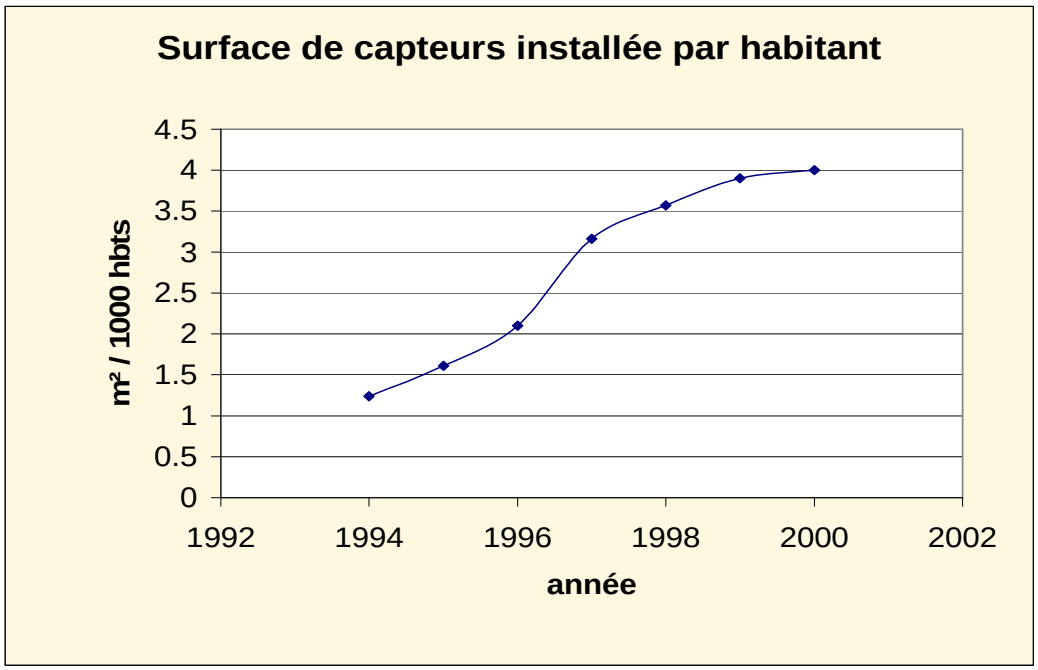
Although the solar market resumed its expansion when the hostilities stopped, ten years later it is still considerably behind the countries of the region at the annual production level as well as at the existing park. Currently in Lebanon, there are 18 fitters at work. We will find below national data on the thermal solar market:

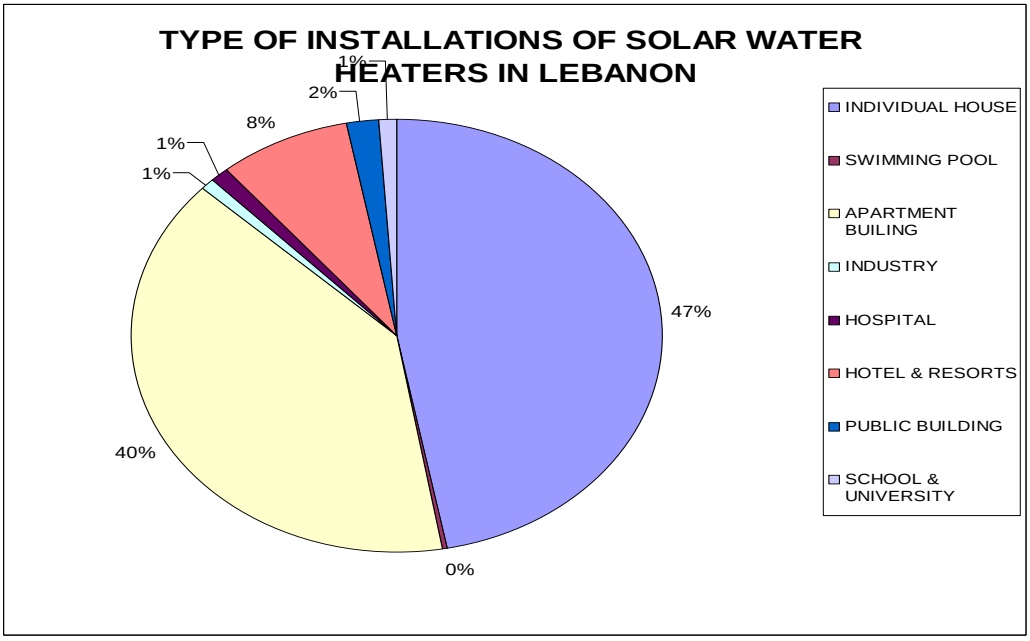
The current prices of collectors in Cyprus are near 105 $/m$^{2.}$ (The FOB of imported collector is lower than the cost of local manufacturing highly penalized by the low manufactured quantities, but its price on the market is higher by 20 to 30%, taking into account transportation expenses and custom duties.)

Currently, the whole park includes 87% of individual water heaters, mainly of “open circuit” type with generally a thermosyphon (more than 70%, the remainder being with a double circuit and pump operated) from which 40% are in collective buildings and the remainder is in individual houses.The installed solar collectors park, today, results in energy economies estimated to be 45 GWh and CO_2 emissions reduction equivalent to 38,000 tons.

Less than 8% are collective installations (in buildings of the tertiary sector) with double circuit (primary and secondary) and are operating with pumps. Guarantee of Solar Result (GSR), an idea introduced by the Energy Efficiency in Building Project (EEBP or PEEC), is not widely utilized in the country. The Zouk project installations, which are part of the GSR programs, are being monitored; the first year’s results were very satisfactory.In 2004, some 22,760 m^2 of collectors were installed, of which less than 12% were imported, i.e. an increase of 550 % from 1994 when the total collectors installed did not exceed 4,300 m^2. There are around twenty fitters operating currently in the local market of which:

- 50% are manufacturers
- 30% are importers

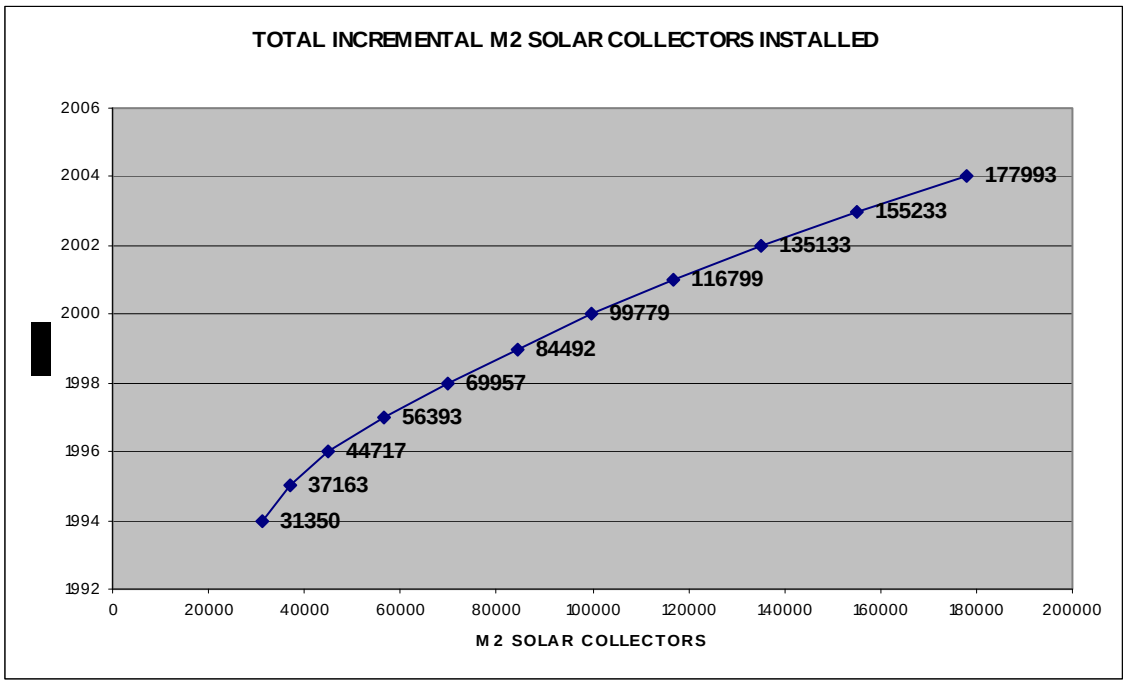

Surface de capteurs installée par habitant
m² / 1000 hbts
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1992
1994
1996
1998
2000
2002
année


TYPE OF INSTALLATIONS OF SOLAR WATER HEATERS IN LEBANON
47%
0%
40%
1%
1%
8%
2%
1%
INDIVIDUAL HOUSE
SWIMMING POOL
APARTMENT BUILING
INDUSTRY
HOSPITAL
HOTEL & RESORTS
PUBLIC BUILDING
SCHOOL & UNIVERSITY

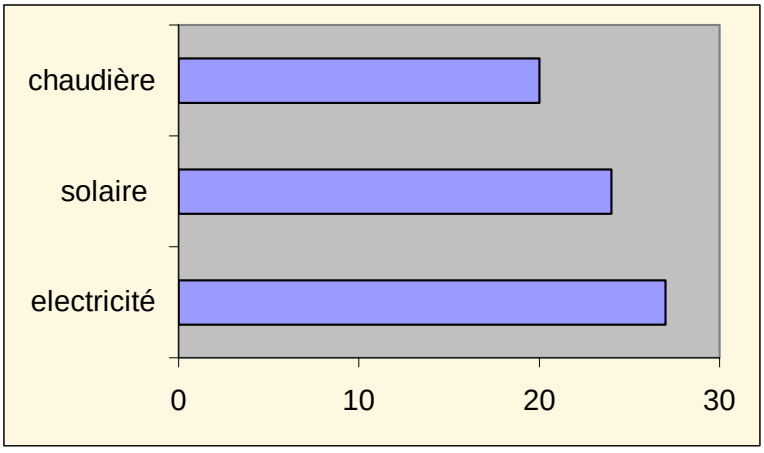
The main consuming sectors of domestic hot water are in the urban area:

Sector	*Nature*	*Number*	*Total Consumption in m3/day*
Residential	Apartments and individual houses	900 000	108 000
Health	Hospitals	145	475
	Clinics	55	3
Hotel	Hotels	218	773
	Furnished apt.	94	367
Education	Schools	1200	140
	Universities	100	80

This consumption of water at 45°C would require about 1,5 Mm² of solar collectors to be assured 100% by the solar energy.

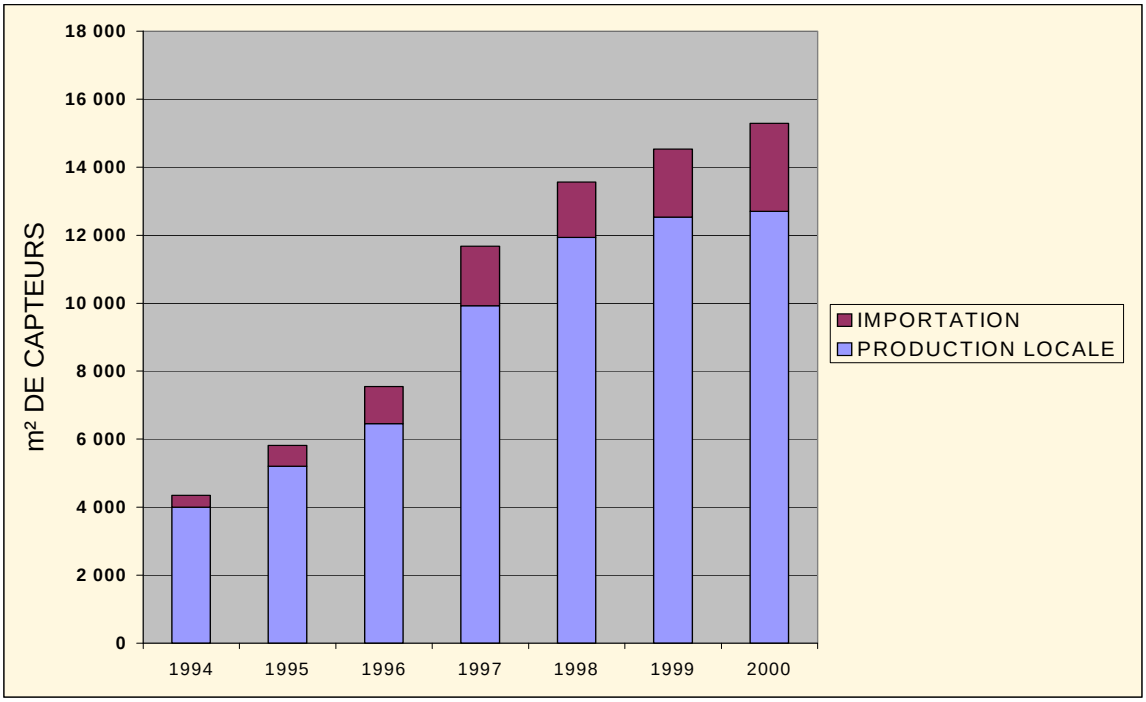


Constraints of implantation such as urbanism or orientation don't permit to consider such a total coverage. Nevertheless, only 10% of coverage needs will lead to a potential market of 150 000 m², which in turn demands more than 10 years to be covered at the actual market rate of about 15 000 m²/year. More than 85% of the actual market concerns the individual installations, of which 50% in collective apartment buildings. These 43% of individual solar collectors (6000 m^2) are not optimized and need in the near future to be provided by collective installations."The Guarantee of solar results (GSR)" notion which was introduced lately thanks to the French GEF-ALMEE « Energy efficiency Project in the Construction in Lebanon », is again very little developed in Lebanon: facilities of the phase1 Zouk project are followed up since nearly one year and results so far are very satisfactory.More than 80% of installed solar systems are locally manufactured by some 10 Lebanese industrials that are mostly members of the "Lebanese Association Of Solar Industrials (ALIS).The average price of an installed Domestic Solar Water Heater (DSWH) system is 260 €/m² of solar collector. This price has been decreasing continuously for the past 5 years. Despite the high price for the Middle East region, the cost of DSWH is competitive relatively to the electricity produced hot water. One should note that 70% of houses still use electricity to produce hot water.



Global actualized cost of solar hot water over 15 years (c€ / litre)

Finally, the environmental impact for using fossil energies is far from being negligible, and the 100000 m^2 of solar collectors in service actually avoid emission of 35 000 tons of CO^2 each year.1%, which makes some few KTOE out of a potential market estimated to be more than 1000 KTOE.



However and in spite of all its advantages, the thermal solar energy in Lebanon is not developed enough compared to countries of the region.

Several barriers prevent the establishment of a favorable dynamic natural market to be expanded:

1. The policy of the energy rates that do not reflect the real cost.
2. The absence of a political will in favor of the solar energy that can make converge the national and macro-economic interests toward those of the consumer and the end user.
3. An insufficient taking into account of the environmental impact and of the public health due the atmospheric pollution.
4. The relatively high price of the DSWH price (about 1 500 €S for a complete DSWH of 3 m² - 200 liters).
5. The quality of water is generally hard and calcareous which leads to a fast deterioration of the DSWH (water tank collectors, heat exchangers,..) dragging an appreciable reduction of the output and the life of the DSWH system.
6. A flagrant lack of sensitization, public awareness and information.

Thermal solar energy remains marginal in the Lebanese energy balance representing less

than 1%, which makes some few KTOE out of a potential market estimated to be more than 1000 KTOE.

Table 1: ECONOMIC BARRIERS TO THERMAL SOLAR MARKET DEVELOPMENT

CONSTRAINTS	IMPACTS	SOLUTIONS and INCENTIVES
1. Energy rates do not reflect the real cost	Development of the electric water heater at the expense of solar Heater.	Energy rates should reflect the direct cost of energy at the short term. At the long term, they should include pollution cost linked to this energy.
2.High investment	High payback >5 to 6 years	1.Advantageous loan for medium and long terms financing. 2.Fiscal incentives.

Table 2: INSTITUTIONAL BARRIERS TO THERMAL SOLAR MARKET DEVELOPMENT

CONSTRAINTS	IMPACTS	SOLUTIONS and INCENTIVES
Absence of political will in favour	Unstable and marginal Market	Adoption of rational energy policies

of solar energy in Lebanon 1-Non-existence of statutory frames 2-Non-existence of development programs for the thermal solar at medium and long terms 3-Absence of financial incentives as well for the industrialist as for the consumer.		and management programs seeking durable development

Table 3: SOCIAL BARRIERS TO THERMAL SOLAR MARKET DEVELOPMENT

CONSTRAINTS	IMPACTS	SOLUTIONS and INCENTIVES
Lack of interest for the solar--Negative public image. 1 – Consumer ignorance of advantages (in medium and long terms) 2 – Ignorance of the macro-economic and environmental stakes	Stagnant and marginal market	1- Information 2 –Sensitization 3 – Training

Table 4: TECHNICAL BARRIERS TO THERMAL SOLAR MARKET DEVELOPMENT

CONSTRAINTS	IMPACTS	SOLUTIONS and INCENTIVES
Discontinuous supply of energy which remains dependent on sunshine hours	Necessity of storage and alternative additional energy	Improvement of storage and additional energy
Icing problem in winter at high Altitude	Collector deterioration	Use of water heater with double circuit (primary and secondary Circuits)
Scaling problem (calcareous water in	Decrease in collectors	1- Use of water heater

with double Lebanon)	efficiency	circuit 2- Use of water softener
Difficult integration of water heaters the building In buildings, especially in urban environment	1- Location 2- Esthetic quality	Forecast “the solar” at design level
Problematical results and uncertain efficiency	Negative image of solar water heater and substandard performances	1- Standards 2- Labeling 3- Guarantee of solar result 4- Technicians training

SUCCESS STORY

French GeF Project; Energy Efficiency in Buildings in Lebanon

The situation in Lebanon is characterized by:

- *A fast development and demand of the construction.*
- *Insufficient electric power production in a sector showing a deficit with tariffs greatly subsidized.*
- *A primary energy almost completely imported from oil derivatives.*

With five pilot operations, the project had objectives to show the technical and economical feasibility of energy improvement for collective housing. The project also aimed, while using results of the operations, to adopt new energy efficiency policies in the housing sector and that by launching public awareness and capacity building campaigns.

The project was proposed by the "Lebanese Association for Energy Efficiency and Environment" (ALMEE) following a cooperation work with the ADEME.

The first demo operation concerned a housing project in Zouk Mosbeh. The promoter "Elissar Contracting and Engineering" was building 64 apartments totaling 3,900 m^2 and some offices and shops.

In phase 2, 4 other sites were selected for demonstration by the ADEME and ALMEE team.

In return for he incremental cost limited to about 5%, two types of improvements were introduced in the program:

- *Energy Efficient Equipment (solar water heater and low consumption lamps*
- *An adapted design of buildings (roof and partitioning insulation, plastering, tightness of openings to prevent infiltration, controlled mechanical ventilation, double glazing, etc…).*

The demo operation included a follow-up mechanism and survey nearby of the users in order to evaluate improvements introduced.

The retained actions on the energy saving in housing at the national level included:

- *The availability of the necessary tools for the construction operators (method of thermal design of the building and the dimensioning of the solar installations).*
- *The promotion of more efficient household equipment and the preparation of management programs for the demand of electric power nearby of the stakeholders.*
- *The sensitization of operators intervening of the big programs of construction in Lebanon.*
- *The availability of minimum thermal regulations for the coastal zone.*

Each of these themes gave place to capacity building workshops for the concerned operators in coordination with the Order of Engineers and Architects.

The incremental cost of the demo operations were financed as follows:

- *In totality by the users for the energy efficient equipment, the project supplying the treasury advance.*
- *Partially for the improvements on the building , of which effects are more difficult to evaluate and present a differed profitability.*

The studies and follow up of the demo were financed by the project.