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Lebanese Center for Energy Conservation Project.

**SOLAR THERMAL SYSTEMS SURVEY FOR THE
LEBANESE MARKET**

BY THE LEBANESE SOLAR ENERGY SOCIETY (LSES)

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1) INTRODUCTION AND BACKGROUND:

This survey concerning solar thermal system in Lebanon was done as a part of contract#05/05 with Lebanese center for Energy conservation (LCEP). A project signed with the United Nations Development Program (UNDP) and Ministry of Energy and water (MEW). The contract calls for the set up of a solar thermal standard for the Lebanese market in collaboration with LIBNOR.

The Lebanese Solar Energy Society (LSES) was chosen as solar thermal expert to conduct this survey and to propose a solar thermal standard for Lebanon.

LSES mission is made of 5 steps listed here below:

- Deliverable 1: Summary report for the survey of the range of Thermal Solar Systems found in the Lebanese market including a comparison with similar Thermal Solar Systems found in the international market.
- Deliverable 2: List of Thermal Solar System standards, used in the region and internationally, suitable for the Lebanese market.
- Deliverable 3: Complete Thermal Solar System standard and label for each size class/range along with detailed TOR for the procurement of the testing facilities for the thermal solar standards.
- Deliverable 4: Assessments report for the enforcement requirements for the label and standard program including recommendations for increased staffing or other resources to bring enforcement capability up to the required level.
- Deliverable 5: Summary report determining the need for a consumer information program to educate consumers both of the new standards as well as how to read and use the new label.

As indicated here above, the survey of solar thermal systems in Lebanon is the first step of this contract and will be presented and analyzed in this report.

The main survey objective is to collect information of companies, products and applications in the field of solar thermal systems in Lebanon in order to set up a standard that will embrace such products and applications, and to assess the Lebanese market supply capabilities of manufactured and imported solar thermal systems.

2) METHOD OF SURVEY:

2.1) Survey questionnaire and terms definitions:

Appendix 1 includes a sample of the questionnaire prepared and used as backbone of this survey. Surveyors were instructed to collect the maximum of information that companies would like to add to this questionnaire.

Main subjects of the questionnaires were developed as follows:

a) Companies' identification and profile:

This chapter is intended to list all companies involved in the solar thermal fields.

b) Proposed equipments:

This section should clarify what are the main solar thermal equipment found on the Lebanese market with their relative shares. We have listed all the known equipment and system used on the international market in order to compare Lebanese market to the international.

A definition of technical words is also provided in appendix 1.

c) Range of application:

This section should clarify what are the main solar thermal applications in the Lebanese market with their relative shares.

d) Equipment brand and origin:

This section is intended to list all the equipment brand and origin.

e) Level of technicalities:

This section should clarify what are the available technicalities (standards, technicians, experts) available within the companies dealing with solar thermal systems.

f) Installed solar capacities:

This section is added to collect more information concerning local production capacities as well as market capacities and installed solar thermal systems. (Informations provided by manufacturers and suppliers).

g) Problems and solutions:

This section should clarify what are the problems and solutions identified by the local actors for the solar thermal systems.

2.2) Survey team and schedule:

a) The survey team:

The survey team was composed of two LSES solar experts and three universities students.

The two LSES experts have each more than 15 years of professional experience in Mechanical Engineering, Energy & Building conservation, and Solar Expertise. Both are graduated from Local and European reputable schools of Mechanical Engineering, both have professional experience in Local, European and Gulf markets .

The three LAU or LU universities students are pursuing Engineering or scientific courses in their last year prior to graduation in an Engineering degree or a Bachelor of Science.

b) Survey schedule:

The survey was conducted from the 15th of July up to the 15th of September 2005.

2.3) Survey panel:

Appendix 2 list all the 24 companies identified, as continuously involved in the solar thermal fields in Lebanon for more than 1 year. Out of these 24 companies, 22 companies are still involved in the solar field.

All the statistical data and percentage will be done based on the panel of 22 companies that have answered the questionnaire. Statistical data are based on answers or estimations given by these companies. No statistical data from the market are available to correlate companies information. We have added some of our own estimations to clarify the picture when required.

3) DATA INTERPRETATION:

A lot of data analysis and interpretation will be done through this survey. We leave to the reader the freedom to make additional analysis out of the raw data attached in the appendices.

a) Companies' identification and profile:

Appendix 3 lists all the 22 surveyed companies. Main conclusions are listed herebelow.

• Solar activity companies starting date:

- 28% (6 companies out of 22) started between 1980 and 1989 (10 years period).
- 36% (8/22) started between 1990 and 1999 (10 years period).
- 36% (8/22) started between 2000 and 2005 (5 years period).

These numbers indicate a quick growing competition between the Lebanese solar thermal actors.

• Geographical distribution:

- Great Beirut: 45% (10/22)
- Mount Lebanon: 22% (5/22)
- North: 10% (2/22)
- Bekaa: 5% (1/22)
- South: 15% (4/22)

All areas are represented but with the highest profile for Beirut and the lowest profile for the Bekaa.

• Suppliers or manufacturers:

- Supplier: 64% (14/22) of the registered companies.
- Manufacturer: 36% (8/22) of the registered companies.

Such ratios are not representative of the market shares which are in favor of the manufacturers (see section f, installed solar capacities).

These ratios are explained by the fact that suppliers need very few investments to add solar systems to their products line, while starting with manufacturing facilities is more difficult. On the other hand, locally made thermal solar systems are generally cheaper than imported systems leading to larger market shares.

b) Proposed equipment found on the Lebanese market:

Appendix 4 gives statistical data for the proposed equipment found in the Lebanese market. Main conclusions are listed herebelow.

- Flat plate collectors still represent the main used equipment with 82% of equipment shares; followed by a steady growth of evacuated tube collectors with 18%, which will probably take additional shares out of the flat plates collectors. Other equipments (such as integrated collectors and EPDM swimming pool collectors) are practically not used in Lebanon. The reason to this is that these two products efficiency is lower than flat plate collectors. Suppliers and manufacturers are proposing flat plate collectors instead (notably for swimming pools).
- Thermosiphon (closed type or open type) is the only complete factory made system proposed as a package (Package forced circulation and integral collector storage system are practically not available in Lebanon. These systems are not well developed in Europe and consequently not imported to Lebanon).

NB: Package forced circulation is a solar system with collector, tank, pumps, piping and controller completely assembled in factory and installed as one package.

This is different from the site assembled forced circulation system which is largely used in Lebanon.

Ratios are:

Closed type thermosiphon: 69%

Open type thermosiphon: 31%

- Hot water tanks are available in all sizes (from 100 liters to 2500 liters) depending on the type of application. (See section c below).

The hot water tanks used on the Lebanese market for solar systems are either imported either locally made.

c) Range of application:

Appendix 5 gives statistical data for the range of applications. Main conclusions are listed here below.

- Application type:

Thermosiphon system: 70% (From which 69% closed type and 31% open type).
Forced circulation for hot water 26%.
Forced circulation for pool heating 3%.
Forced circulation for space heating 1%.

Thermosiphon remains the main application for the flat plate and evacuated tube collectors.

However it should be noted that forced circulation use lot more solar panels square meters than thermosiphon since it can be used for large commercial and industrial applications.

- Typical application size:

Less than 6m² solar collectors: 72%.
Between 7m² and 20m²: 20%.
Between 21 and 100m²: 7%.
Above 100 m²: 2%

- Typical users:

Residential individual (apartments, villas...): 61%.
Residential buildings (collective buildings): 24%.
Large commercial (hotel, hospital...): 10%
Retail : 4%
Industrial: 1%

These percentages clearly indicate that individual solar systems are still the main applications, with some applications for commercial and collective buildings.

- Users areas:

Cities: 51% (more than 100 000 inhabitants including surrounding suburbs)
Villages: 49%.

These ratios show that solar thermal systems can also be installed in cities, while some analysis were predicting application only in villages.

It is to be noted that such ratios are quite the same for suppliers and manufacturers.

d) Equipment brand name and origin:

Appendix 6 gives the equipment brand name and origin. It is to be noted that except for products manufactured in Lebanon; The main sources of equipment are Turkey, Greece, China and then very few from France and Germany. This indicates a clear preference of the Market for relatively low cost products.

Few suppliers and manufacturers proposed technical catalogues with stated technical performances of the solar collectors.

e) Level of technicalities:

Appendix 7 gives statistical data for such level of technicalities. Main conclusions are listed herebelow.

• Manufacturers testing facilities: (based on 8 manufacturers)

Visual test 25% (2manufacturers out of 8)

Pressure test 88% (7/8)

Thermal performance 37% (3/8)

Wind resistance test 0% (1/8)

Freeze resistance test 12% (1/8)

• Manufacturers and suppliers technical personnel:

- Specialized Engineers 50% (11/22)

- Foremen 77% (17/22)

- Skilled labor 91% (20/22)

Solar system is still not completely considered as requiring technical skills . This probably explain failures of operation of some solar installations.

f) Installed solar capacities:

Appendix 8 gives tables for installed solar capacities by suppliers and manufacturers.

We should stress that the requested informations were not all answered by companies. Some extrapolations have been made based on our knowledge of the market in order to give coherent values.

Consequently these values should only be considered as estimations.

Main conclusions are listed herebelow.

- In 2004: manufacturers had 72% of the market share compared to 28% for suppliers. This value clearly indicates that market is primary motivated by cost of equipment cheaper with manufacturers. (price estimations are given in appendix 10).
- Market growth is quickly increasing between 16% in 2001 and 36% in 2004. Our estimation for 2005 is around 18% increase from 2004. This important growth is due mainly to three factors :
 - *Increasing or high cost of energy (electricity fuel high costs)
 - *Lebanese market is catching up his lateness compared to other countries already equipped since the eighties with solar systems.
 - *Solar companies are increasing slowly but steadily their advertising and information efforts.

Potential of growth is still huge with only 120 000m² installed out of possible 2 millions m² (6%).

- In 2004 only 38% of the local present production capacity has been installed, leaving a large margin for a quick market increase.
- The total installed solar system capacities is estimated over the last 5 years at 55 000 m², to be added to estimated 51 000m²(see appendix 10 for estimated references) installed prior to 2001. From these estimations once can deduct a total yearly present saving of 97471 MWh or 78 000 tons of CO₂ or 6.8 Millions USD at present energy cost.
- Forecast up to the year 2010 are also presented in appendix 10, with two scenarios ; one without government support and the second with government support. Forecast are based on present energy and economical trends.

g) Problems and solutions:

Appendix 9 gives tables for main problems and solutions identified by suppliers and manufacturers. Main observations to increase solar users are listed herebelow.

36% of companies insist on conducting advertising campaign to increase awareness of solar advantages.

32% of companies believe that solar installation cost should be reduced .

23% of companies stressed on the need to good quality service and product.

23% of companies stressed on the need to help financing Solar Systems. Other less identified problems and solutions are listed in appendix 9.

Most of the companies have not mentioned more than two problems or solutions to increase solar thermal usage. Moreover same problems are facing most of the manufacturers and suppliers.

h) Comparison with international markets:

Appendix 12 gives a comparative table of market penetration of solar products , applications and users in different part of the world.

Nota bene: Prior to analysis we should point out to the reader that evaluation criterias of market penetration outside Lebanon are based on our perception of such penetration, through our readings of specialized magazines (reports, advertisements, internet research etc..) .It is not the scope of this survey to study in details markets outside Lebanon.

- Lebanese market profile is very similar to neighboring arab countries for solar products, applications and users ; with a slightly better penetration of evacuated tubes in Lebanon. (probably due to lebanese market quick response to new products)
- Lebanese market profile is also very similar to maghreb countries, except that these latest are better equipped with large solar systems , notably for large commercial applicatons (hotels etc..) this is probably due to the converging factors of large scale tourism development and southern Europe technological influence.
- Mains differences between Lebanese and European markets are that sizes of solar systems are larger in Europe and reach easily other than residential users (such as large commercial and industrial applications). On the other hand lebanon's seems more open to evacuated tubes products coming from China, while European countries are more protecting their flat plate collectors manufacturing industry from China competition.

- North America and Australia market profile is close to Europe except with one particularity which is the large development of unglazed collectors due to large quantities of pools. Lebanon's market is not really sensible to unglazed collectors.
- China's market is massively dominated by evacuated tube technology ,applied to all type of applications and users. Lebanese market is sensible to this product, integrating it to its market faster than all other countries, with the risk of slowing local production of flat plate collectors.
- Finally integral collector-storage system are rarely used all over the world, including Lebanon . this probably means that such product has failed to find its market share.

4) RECOMMENDATIONS:

With less than 120 000m² of solar collectors installed, but with an average yearly growth of 20%; the Lebanese Solar market is starting a long path to reach the 2 millions m² estimated possible target.

This growth should be supported by good quality products and services at a reachable price, in order to avoid bad experiences.

Consequently and within the frame of our mission to set up a Solar Standard, we recommend the followings:

- 1) Prepare a Solar Collector Standard valid for flat plate and evacuated tube collectors.
- 2) Prepare a standard for Solar Thermosiphon.
- 3) Both standards should have two levels of requirements. The first level to be mandatory to reach the minimum acceptable requirements without increasing prices of products on the local market, and the second level to be recommended to reach International Level Standards.
- 4) Labeling will be based on the above two levels helping consumers identifying quality /price ratio.
- 5) Such requirements and labels should be implemented by a certified institute with enough technical capabilities and personnel.

On the other hand but outside our scope of work we also recommend the following actions to be taken by concerned parties .

- a) Increase awareness through intensive advertising campaign.
- b) Create financial incentives for solar thermal systems.
- c) Implement policies and laws to support solar installation.

APPENDIX 1

Survey Questionnaire and terms definitions

Lebanon cross Sectoral Energy Efficiency and
Removal of barriers to ESCO operations

Project: Lebanese Solar thermal systems
QUESTIONNAIRE

Company name:
Contact person:
Phone number:
Fax number:
Solar activity starting Date:
Full address:

Proposed Equipment :

Solar collector:	%	Manufacturer/Supplier M or S
Flat plate	<input type="checkbox"/>	<input type="checkbox"/>
Evacuated tube	<input type="checkbox"/>	<input type="checkbox"/>
Black EPDM mattress for pool	<input type="checkbox"/>	<input type="checkbox"/>
Integral collector-storage system	<input type="checkbox"/>	<input type="checkbox"/>
Other:	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

Solar hot water tank:	%	Manufacturer/Supplier M or S
Up to 200 liters	<input type="checkbox"/>	<input type="checkbox"/>
Between 201 & 300 liters	<input type="checkbox"/>	<input type="checkbox"/>
Between 301 & 400 liters	<input type="checkbox"/>	<input type="checkbox"/>
Between 401 & 500 liters	<input type="checkbox"/>	<input type="checkbox"/>
Above 501 liters	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

UNDP

Complete factory made system:	% Manufacturer/Supplier	
	M or S	
Thermosiphon for hot water Closed circuit	<input type="checkbox"/>	<input type="checkbox"/>
Thermosiphon for hot water open circuit	<input type="checkbox"/>	<input type="checkbox"/>
Integral collector-storage system	<input type="checkbox"/>	<input type="checkbox"/>
Package forced circulation system	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

Range of application :

Application type:	%
Thermosiphon for hot water	<input type="checkbox"/>
Integral collector-storage hot water system	<input type="checkbox"/>
Forced circulation for hot water	<input type="checkbox"/>
Forced circulation for pool heating	<input type="checkbox"/>
Forced circulation for space heating	<input type="checkbox"/>

Comments:

Application size:	%
Less than 6 m ² solar collectors	<input type="checkbox"/>
Between 7m ² and 20 m ²	<input type="checkbox"/>
Between 21m ² and 100 m ²	<input type="checkbox"/>
Above 100 m ²	<input type="checkbox"/>

Comments:

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Users:

%

Residential buildings

Residential individual

Retails

Large commercial (hotels, hospitals...)

Industrial

Comments:

Areas:

%

Cities

Villages

Comments:

UNDP

Equipment brand name & origin :

Solar collector brand name & origin:

Solar hot water tank name & origin:

Complete factory made system brand name & origin:

Attached documentation:

- | | |
|-----------------------------------|--------------------------|
| catalogs | <input type="checkbox"/> |
| Data sheets | <input type="checkbox"/> |
| specifications | <input type="checkbox"/> |
| Photos | <input type="checkbox"/> |
| certificates | <input type="checkbox"/> |
| Price list (systems & components) | <input type="checkbox"/> |

Level of technicalities :

Testing facilities:	Yes/No	comments
Visual test	<input type="checkbox"/>	
Pressure test	<input type="checkbox"/>	
Thermal performance test	<input type="checkbox"/>	
Wind resistance test	<input type="checkbox"/>	
Freeze resistance test	<input type="checkbox"/>	
Others	<input type="checkbox"/>	
Comments:		

Technical personnel:	Yes/No	comments
Engineer	<input type="checkbox"/>	
Technician	<input type="checkbox"/>	
Skilled labor	<input type="checkbox"/>	
Comments:		

Applicable standards:	Yes/No	comments
Standards on raw material	<input type="checkbox"/>	
Standard on fabrication process	<input type="checkbox"/>	
Standard on finished product	<input type="checkbox"/>	
Comments:		

UNDP

Production

How many solar collector square meter you can produce per year (Manufacturers only):

How many solar collector square meter you are really producing(or importing) per year:

2005:

2004:

2003:

2002:

2001:

Problems & Solutions

What are the obstacle to increase use of solar systems in your region :

What are the solutions or measures to increase use of solar systems in your region :

Did you hear about the project of Energy Efficiency with UNDP :

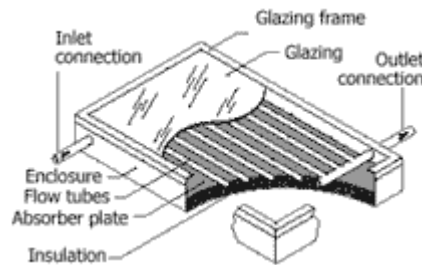
Definitions of terms

Types of Collectors and Thermal Solar Systems

I. Types of Solar Collectors:

1. **Glazed Flat-Plate Collectors:**

A glazed flat-plate collector consists of a shallow rectangular box with a flat black plate behind a tempered glass cover. The plate is attached to a series of parallel tubes or one serpentine tube through which water or another liquid (such as an antifreeze solution) passes. As the liquid circulates through the system, it absorbs the heat from sunlight falling on the collectors. The heated liquid then enters a heat exchanger or is added directly to the conventional system. In commercial applications, the solar-heated water flows to a storage tank that is connected to the conventional water heating system. Although flat-plate solar collectors are less efficient in cold weather than in warm, they can still supply 25 to 35 percent of a company's annual hot water needs. These systems are best suited to applications that require medium to high temperatures (40 to 60°C).



2. **Evacuated-Tube Collectors:**

An evacuated-tube collector contains several individual double layer glass tubes with vacuum between both layers. Different type of internals are available depending on the application. The evacuated tube transfers the heat efficiently to a well-insulated water collector or a well-insulated water tank.

Cold weather and high water temperatures have little effect on evacuated-tube collectors, which can supply water at more than 80°C.



3. Unglazed Collectors:

Unglazed collectors are specially designed for low-temperature (30 °C) applications such as the heating of swimming pools and aquaculture process water. Most unglazed collectors on the market are made of either rubber or UV-stabilized polymer plastic. Polymer plastic collectors are semi-rigid and become more pliable when heated. These types of collectors come in a variety of shapes and sizes and can last from 15 to 20 years. Rubber collectors come in flexible strips and can last up to 15 years. Efficiency ratings for UV or rubber collectors vary between products, so be sure to ask your dealer or manufacturer about the efficiency of their collectors.



II. Solar water heating system can also be classified in 2 types based on the circulation of water.

1. Thermosyphon system.
2. Forced flow or forced circulation system.

1. Thermosyphon system:

In the thermosyphon system, water comes from the over head tank to bottom of solar collector by natural circulation and water circulates from the collector to storage tank as long as the absorber keeps absorbing heat from the sun and water gets heated in the collector. The cold water at the bottom of storage tank run into the collector and replaces the hot water, which is then forced inside the insulated hot water storage tank. The process of the circulation stops when there is no solar radiation on the collector. Thermosyphon system is simple and requires less maintenance due to absence of controls and instrumentation.

2. Forced circulation system:

In the forced flow system, a pump is used for circulating water between the collectors and the insulated hot water storage tank. The forced flow systems are more efficient as compared to thermosyphon systems due to higher flow rate. Generally, the pumps are operated by differential temperature control (DTC) system, which senses the pre-setting temperature difference between inlet and outlet of the collectors.

- ✚ **Solar water heating systems are also further classified as Direct System (Open Loop System) and Indirect System (Closed Loop System).**

Open Loop System:

The Direct System is the one where the water circulates through the entire system i.e.

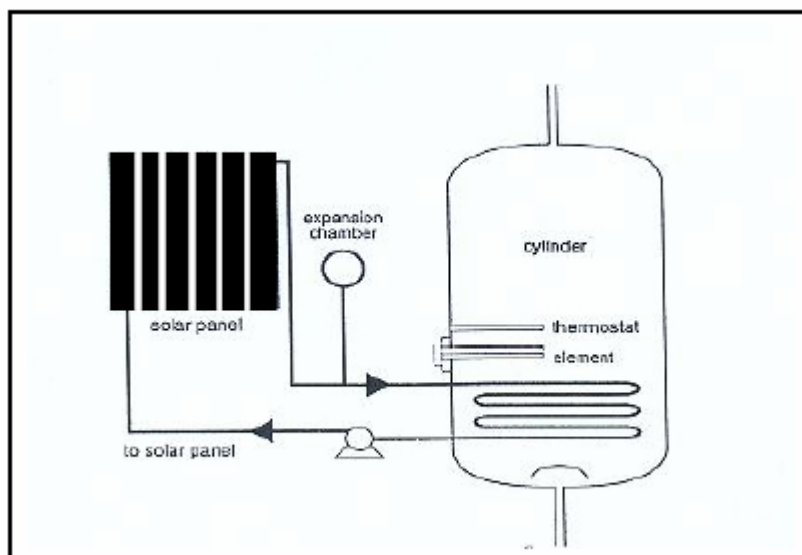
collector to storage tank and the same hot water is used for various applications. These type of systems are generally not suitable for hard water due to the scaling problems in the risers and headers of the collector. Moreover they can not be installed in freezing areas where antifreeze product should be added.

Closed Loop System:

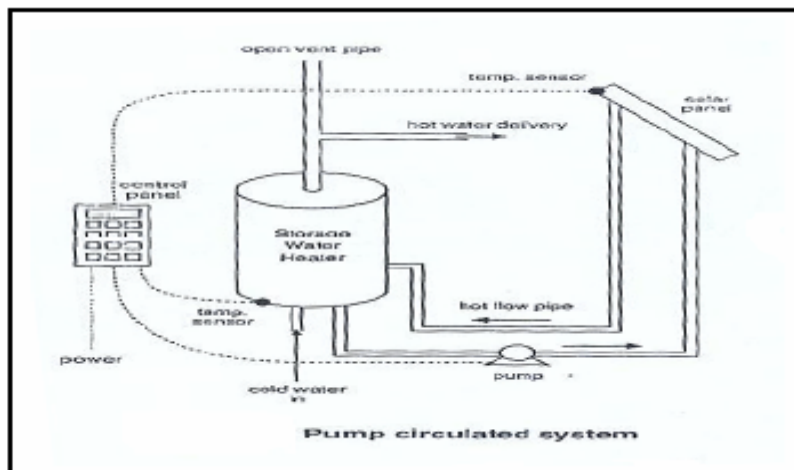
In the Indirect System, the thermal fluid is circulated between the collector and the insulated storage tank with heat exchanger. The heat from the thermal fluid is then transfer to the water through heat exchanger in the storage tank. In this system, the thermal fluids are not in physical contact with the water in storage tank. These systems are generally suitable for hard water, antifreeze fluid can be added to the thermal fluid

Examples of a forced open loop circulating system and a forced closed loop circulating system

Indirect closed looped system



Direct open looped system



APPENDIX 2

Survey Panel

UNDP/LCECP

#	Company name	contact person	Phone number	Fax number	address	category	AREA
1	ADEL ABOU HABIB & CO	Adel BOU HABIB /Rachid BOU HABIB	01-870087/ 01 8700822	01-884485	JdeiditEI - Meten	Supplier	BEIRUT
2	AI-BINA	Lynn TABBARA	01-374287/8/9 / 03-382067	01-371864	Clemonceau	Supplier	BEIRUT
3	AQUATHERMA	Charbel HACHEM	05-43979 / 09-477154	05- 950827/09- 477273	Baabda	Supplier	BEIRUT
4	ATON	Nabih CHEDID	03-744104		Jdeidit EI - Meten	Supplier	BEIRUT
5	DAWTEC	Jihad DAW				Supplier	BEIRUT
6	DEBBAS ENTERPRISE s.a.l	Tony KHOURY	01-486240/5	01-486238	Mkalles	Supplier	BEIRUT
7	Ets Adib BAHNAM	Bahnam Bahnam	01-268100	01-260006	Dora	Supplier	BEIRUT
8	FAKIH					Manufacturer	SOUTH
9	FALCON WIN TRADING	Assaad SLAIBY	03-694005 / 08-910335	08-911000	Kassarnaba	Manufacturer	BEKAA
10	GHADDAR TRADING & INDUSTRY	Reda GHADDAR	07-221956			Manufacturer	SOUTH
11	KYPROS Solar System	Hanna AKAR	01-255400/ 03-888588	01-255400	Dawra	Manufacturer	BEIRUT
12	LSECO SOLAR	Mostapha GHADDAR	01-701807/ 07-721813	01-309271	1)Beirut 2)Saida	Manufacturer	SOUTH
13	RAY SOLAR ENERGY	Fares MALLAEB	05-570420/ 03-778361			Supplier	SHOUF
14	SAADEDINE					Manufacturer	NORTH
15	SIEMENS SOLAR ENERGY- ETS.FAWZI MAALOUF	FAWZI MAALOUF	03-226099 / 03-763986		Dawra	Supplier	BEIRUT
16	SKY ENERGY s.a.r.l.	Gilbert ZABBAL/Ramzi JABBER	05-457968	05-457968	Babda	Supplier	BEIRUT
17	SOLAHART LEBANON	Hussein ABDALLAH	01-820769 / 01-838012	01-854093	Bir Hassan	Supplier	BEIRUT
18	SOLAR POWER		05-950607/ 03-303392		Hazmieh	Supplier	BEIRUT
19	SOLARNET	Jean Paul SFEIR /Joseph SEMAAN	03-309885 / 03-954876	01-614347	Achrafieh	Manufacturer	BEIRUT
20	TFAILY SOLAR ENERGY		03-720129	07-530330	ZahrAni	Manufacturer	SOUTH
21	WEBCO / CESL	Maher EI BABA	01-850068 / 01-853047	01-853711	Beyrouth	Supplier	BEIRUT
22	ZREIK for trading and contracting	Walid ZREIK	03-201608	06-202566	TRPOLI	Supplier	NORTH

Companies not working anymore in Solar Energy

23	WHITE WATER	Gaby MRAD	03-660847		Al Koura	Manufacturer	NORTH
24	OVERSEAS CONSULTANTS	Vahé ZAVZAVODJIAN	01-368316 / 01-368285	01-367344	Clemonceau	Supplier	BEIRUT

APPENDIX 3

Companies Profile

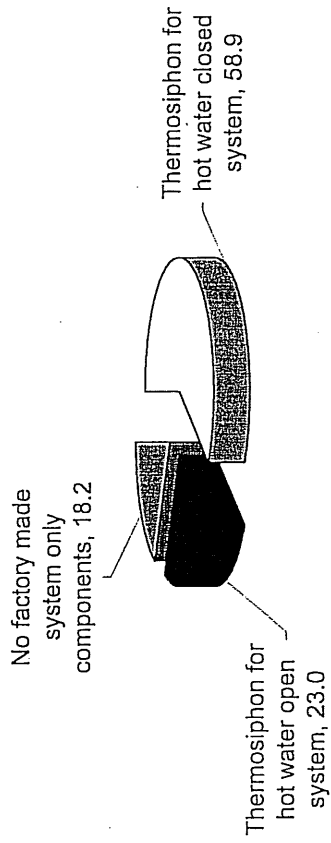
Profile

Company Name	Activity	Contact Person	Phone Number	Fax Number	Solar Activity starting date	Address
Adel Bou Habib & Co	Supplier	Rachid Bou Habib	01-870087	01-884485	2002	Beirut
Adib BAHNAM	Supplier	Bahnam Bahnam	01-268100	01-260006	2002	Beirut
Al-Bina	Supplier	Fadi Abu Sharaf	03-751065	01-371864	2001	Beirut
Aquatherma Engineering	Supplier	Charbel Hachem	09-477154	09-477273	1985	Jbeil
ATON	Supplier	Nabih Shdid	03-744104		2003	Beirut
Dawtec	Supplier	Wissam Daw	03-947345	01-292929	2002	Beirut
Debbas Entreprise	Supplier	Youssef Kassab	01-486237	01-486238	1998	Beirut
Etablissement Kanaan for trading (Solar Power)	Supplier	Assaad Kanaan	05-950607	05-950607	1994	Baabda
Fakih	Manufacturer	Ahmed Fakih	07-760391	07-530856	1985	Nabatieh
Falcon Win Trading	Manufacturer	Assaad Slaiby	08-910521	08-911000	1991	Zahle
Ghaddar Trade & Industry (Sunfire)	Manufacturer	Reda Ghaddar	07-221956	07-220512	1994	Saida
Kypros	Manufacturer	Samar Akar	03-888588	01-255400	1996	Beirut
Middle East Scandenavian Marketing Office (Zreik)	Supplier	Walid Zreik	06-202566	06-202566	1985	Tripoli
RAY Solar Energy	Supplier	Fares Mlaeb	05-570420		2004	Aley
Saadeddine	Manufacturer	Elias Saadeddine	06-250191	06-250191	2000	Denniye
Siemens	Supplier	Samar Akar	03-888588	01-255400	1996	Beirut
Sky Energies	Supplier	Gilbert Zabbal	05-457968	05-456566	1996	Baabda
Solarhart	Supplier	Kamel Al Sharkawi	03-606578	01-854093	1995	Beirut
Solarnet	Manufacturer	Jean-Paul Sfeir	03-309885	01-614347	2002	Kesserwan
Sunco (ex Lseco)	Manufacturer	Rajaa Ghaddar	07-752689	07-752689	1980	Saida
Tfaily Solar Energy (Sunshine)	Manufacturer	Sami Tfaily	07-530330	07-530330	1985	Zahrani
WEBCO/CESL division	Supplier	Maher El-Baba	01-850068	01-853711	1985	Beirut

APPENDIX 4

Proposed Equipment

Complete factory made system proposed by manufacturers & suppliers



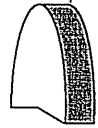
	Thermosiphon for hot water closed system	Thermosiphon for hot water open system	No factory made system only components
Manufactures and suppliers	58.9	23.0	18.2

Complete factory made system proposed by suppliers

No factory made system only components, 28.57



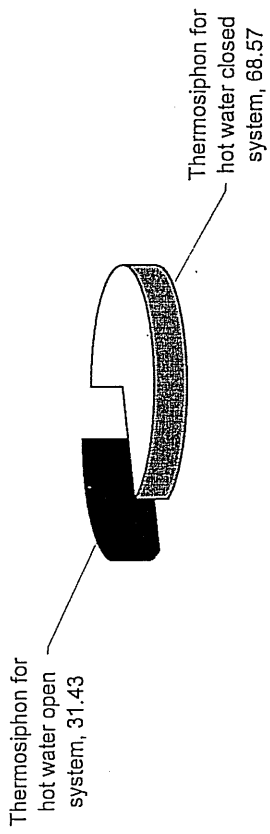
Thermosiphon for hot water open system, 18.93



Thermosiphon for hot water closed system, 52.50

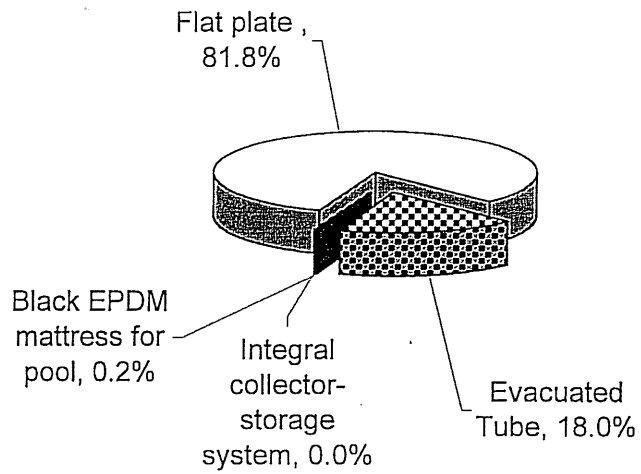
	Thermosiphon for hot water closed system	Thermosiphon for hot water open system	No factory made system only components
Supplier	52.50	18.93	28.57

Complete factory made system proposed by local manufacturers



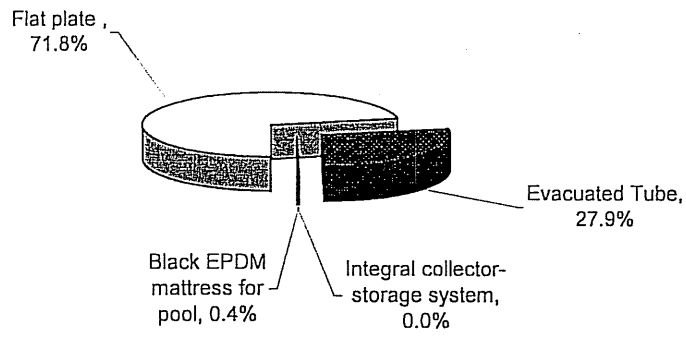
	Thermosiphon for hot water closed system	Thermosiphon for hot water open system
Manufacturer	68.57	31.43

Solar collector proposed by manufacturers & suppliers



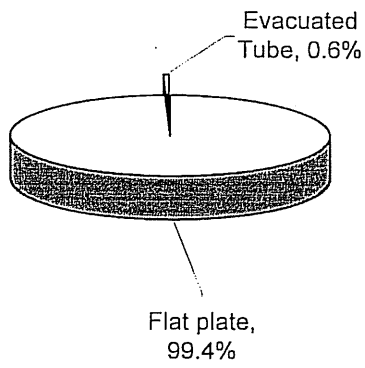
	Flat plate	Evacuated Tube	Black EPDM mattress for pool	Integral collector- storage system
Suppliers Equipment %	81.8%	18.0%	0.2%	0.0%

Solar collector proposed by importing suppliers



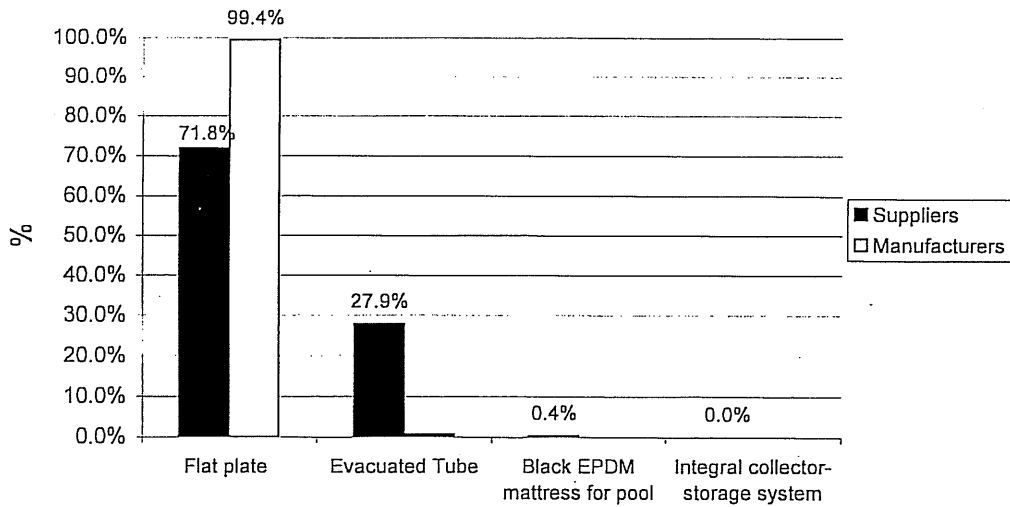
	Flat plate	Evacuate d Tube	Black EPDM mattress for pool	Integral collector- storage system
Suppliers	71.8%	27.9%	0.4%	0.0%

Solar collector proposed by local manufacturers



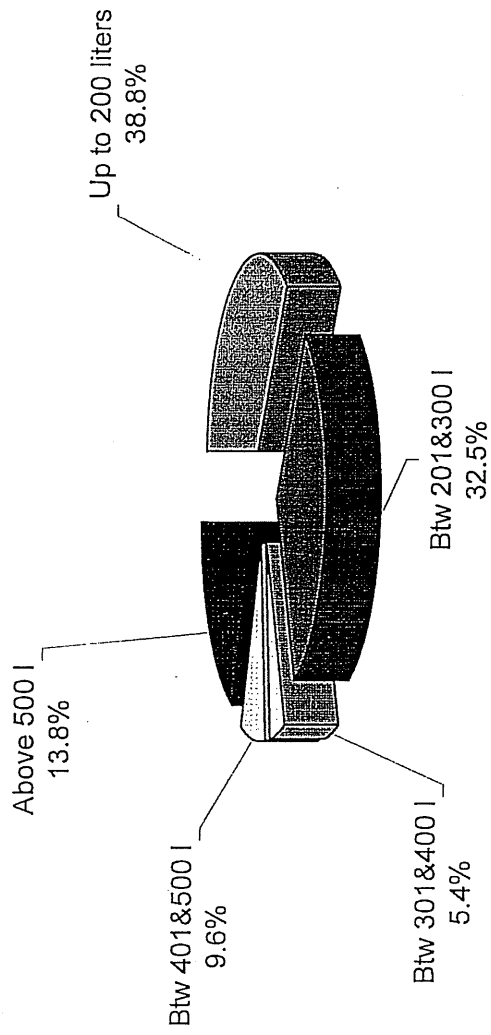
	Flat plate	Evacuated Tube
Manufacturer	99.4%	0.6%

Correlation between solar collector provided versus manufacturer/Supplier



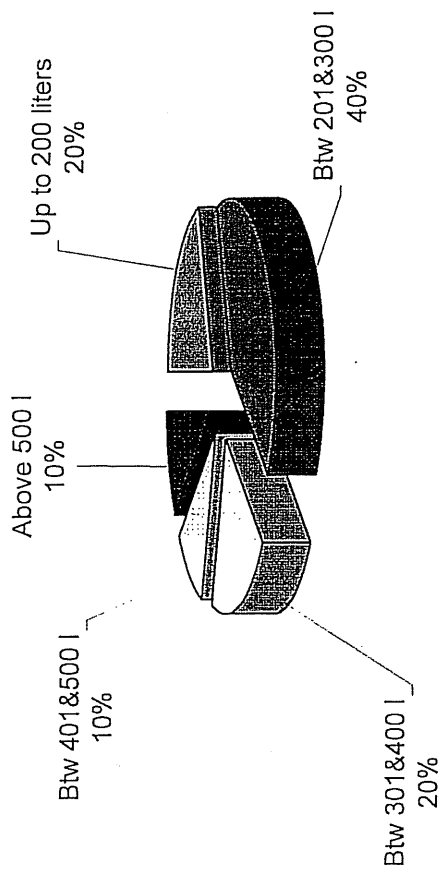
	Flat plate	Evacuated Tube	Black EPDM mattress for pool	Integral collector-storage system
Suppliers	71.8%	27.9%	0.4%	0.0%
Manufacturers	99.4%	0.6%	0.0%	0.0%

Solar hot water tank proposed by suppliers



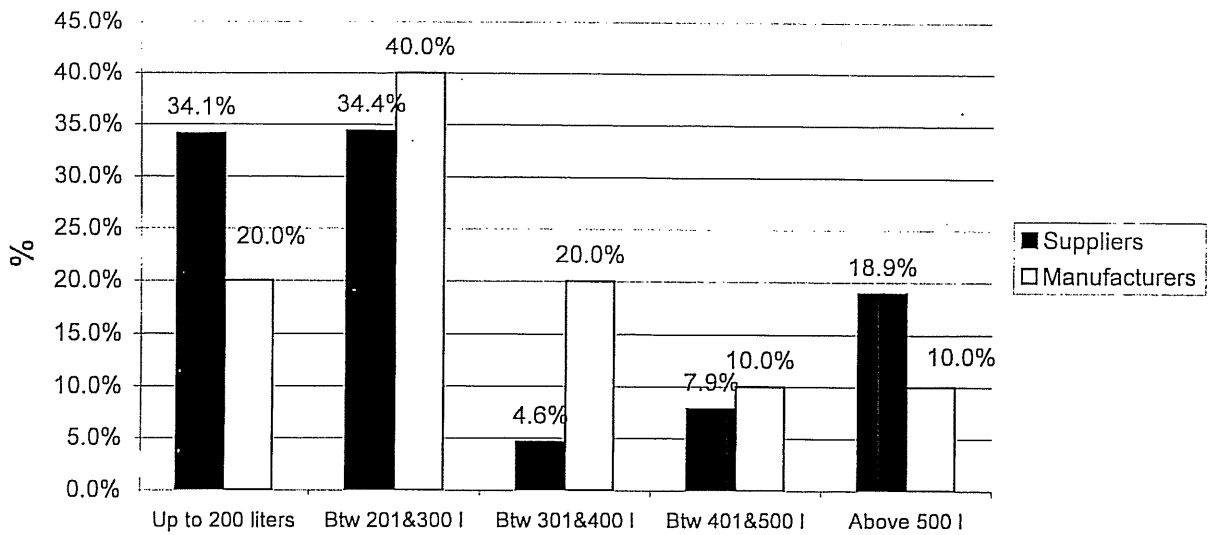
Suppliers	Up to 200 liters	Btw 201&300 l	Btw 301&400 l	Btw 401&500 l	Above 500 l
	34.1%	34.4%	4.6%	7.9%	18.9%

Solar hot water tank proposed by manufacturers



Manufacturers	Up to 200 liters	Btw 201&300 l	Btw 301&400 l	Btw 401&500 l	Above 500 l
	20.0%	40.0%	20.0%	10.0%	10.0%

Comparison between solar hot water tank proposed by manufacturers & suppliers

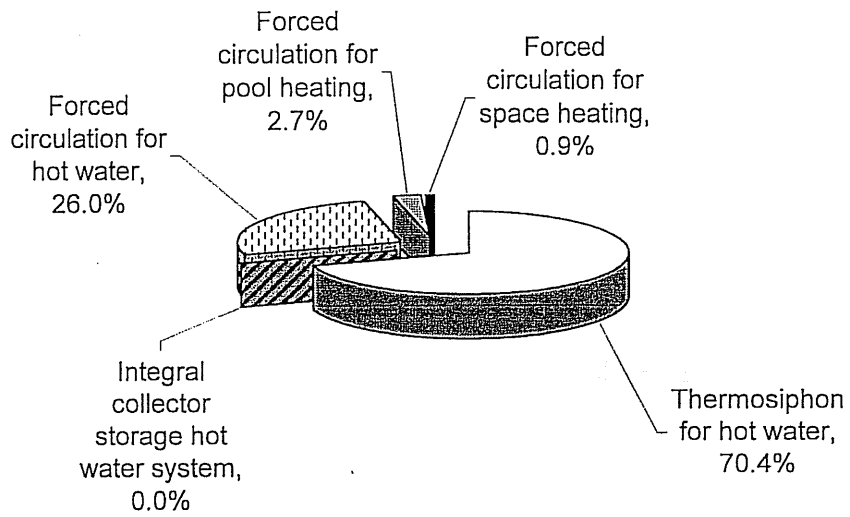


	Up to 200 liters	Btw 201&300 l	Btw 301&400 l	Btw 401&500 l	Above 500 l	
Suppliers	34.1%	34.4%	4.6%	7.9%	18.9%	100.0%
Manufacturers	20.0%	40.0%	20.0%	10.0%	10.0%	100.0%

APPENDIX 5

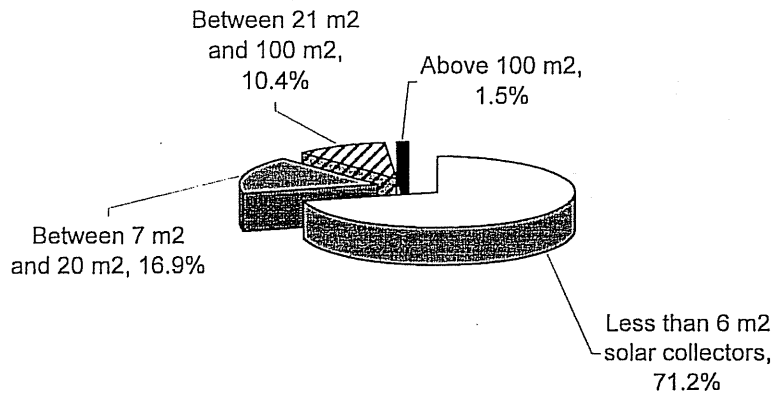
Range of Application

Manufacturers & Suppliers Application Type



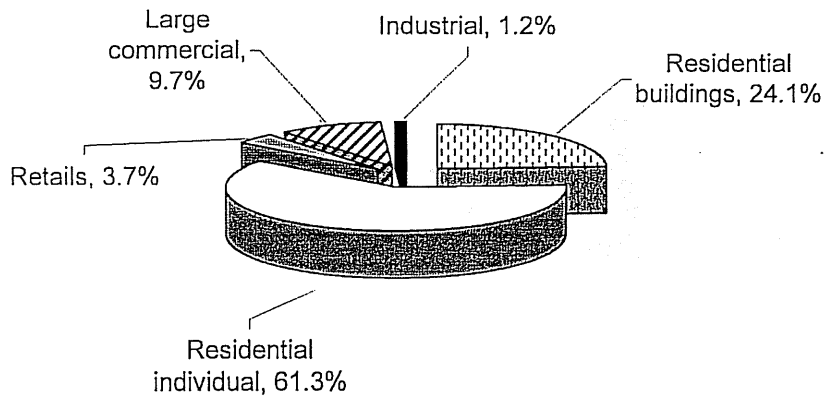
	Thermosiphon for hot water	Integral collector storage hot water system	Forced circulation for hot water	Forced circulation for pool heating	Forced circulation for space heating
Manufacturers & Suppliers	70.4%	0.0%	26.0%	2.7%	0.9%

Manufacturers & Suppliers Application Size



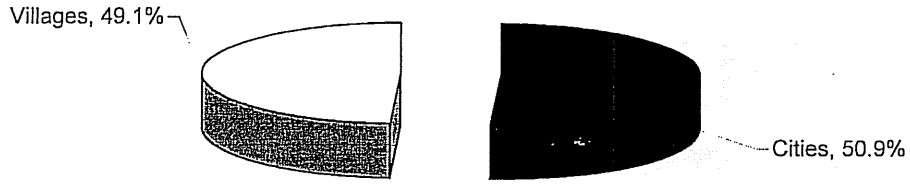
	Less than 6 m2 solar collectors	Between 7 m2 and 20 m2	Between 21 m2 and 100 m2	Above 100 m2
Manufacturers & Suppliers	71.2%	16.9%	10.4%	1.5%

Manufacturers & Suppliers provide their equipment mainly to



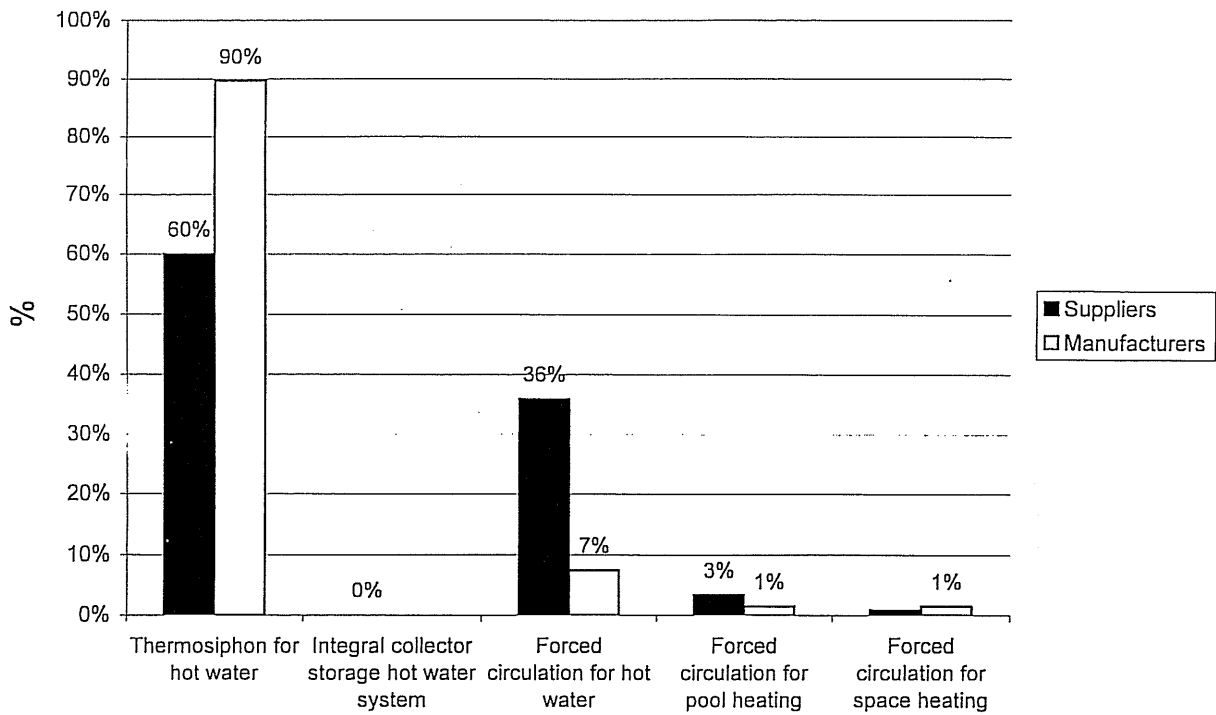
	Residential buildings	Residential individual	Retails	Large commercial	Industrial
Manufacturers & Suppliers	24.1%	61.3%	3.7%	9.7%	1.2%

Manufacturers & Suppliers provide their equipment mainly to



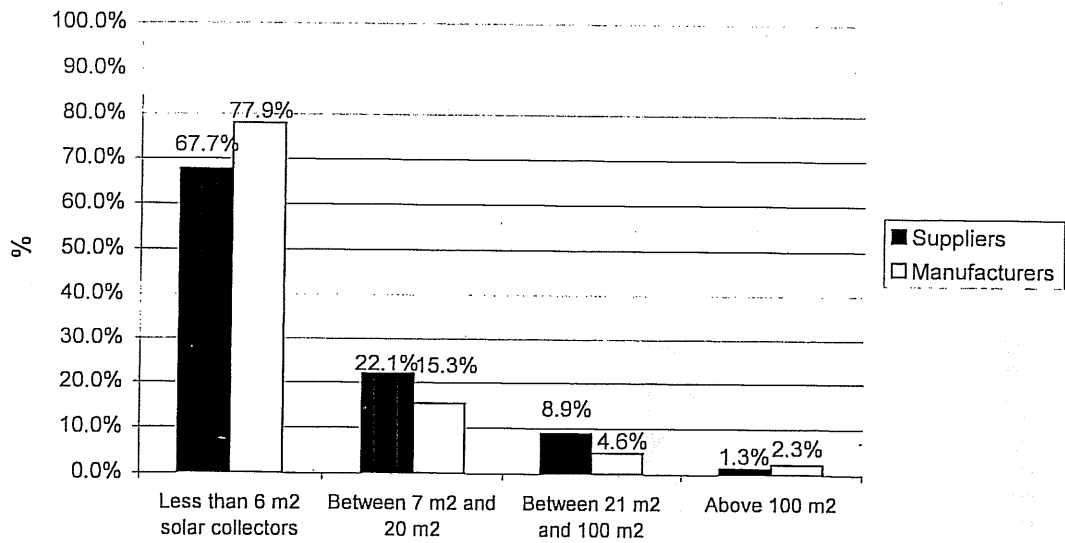
	Cities	Villages
Manufacturers & Suppliers	50.9%	49.1%

Comparison between manufacturers and suppliers application type



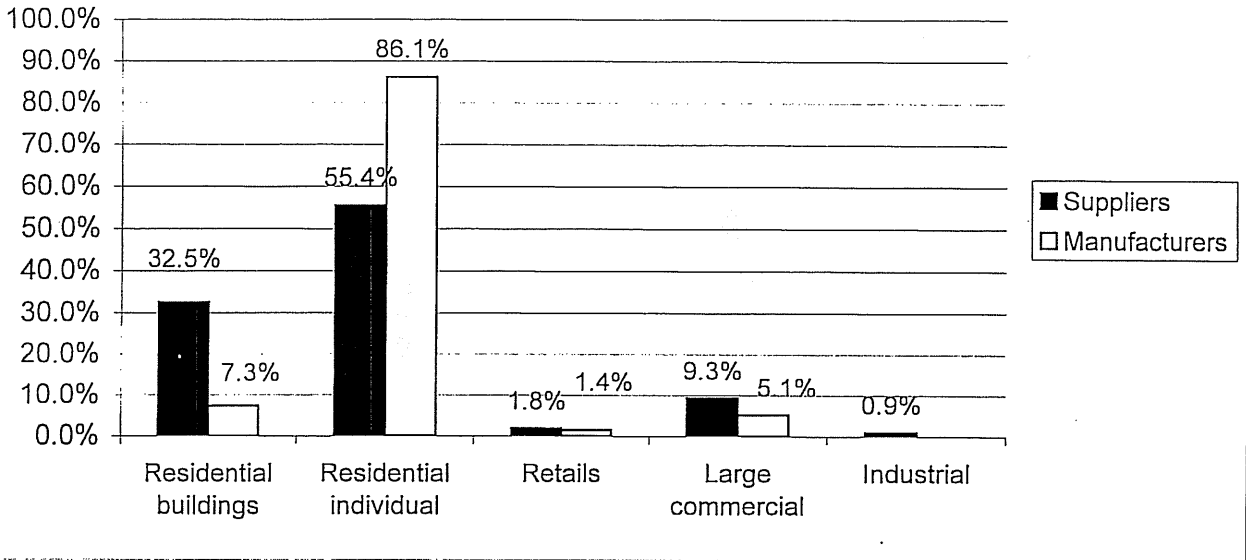
	Thermosiphon for hot water	Integral collector storage hot water system	Forced circulation for hot water	Forced circulation for pool heating	Forced circulation for space heating
Suppliers	60%	0%	36%	3%	1%
Manufacturers	90%	0%	7%	1%	1%

Comparison between manufacturers and suppliers application size



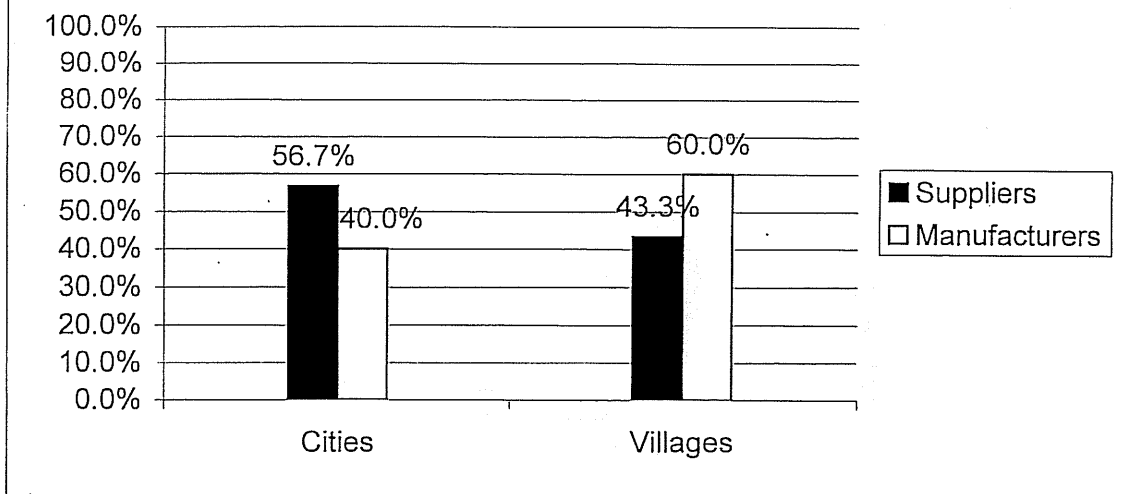
	Less than 6 m2 solar collectors	Between 7 m2 and 20 m2	Between 21 m2 and 100 m2	Above 100 m2
Suppliers	67.7%	22.1%	8.9%	1.3%
Manufacturers	77.9%	15.3%	4.6%	2.3%

Comparison between the users of the manufacturers & suppliers



	Residential buildings	Residential individual	Retails	Large commercial	Industrial
Suppliers	32.5%	55.4%	1.8%	9.3%	0.9%
Manufacturers	7.3%	86.1%	1.4%	5.1%	0.0%

Comparison between the areas that benefit from manufacturers & suppliers products



	Cities	Villages
Suppliers	56.7%	43.3%
Manufacturers	40.0%	60.0%

APPENDIX 6

Equipment Brand and Origin

Equipment & Brand Name

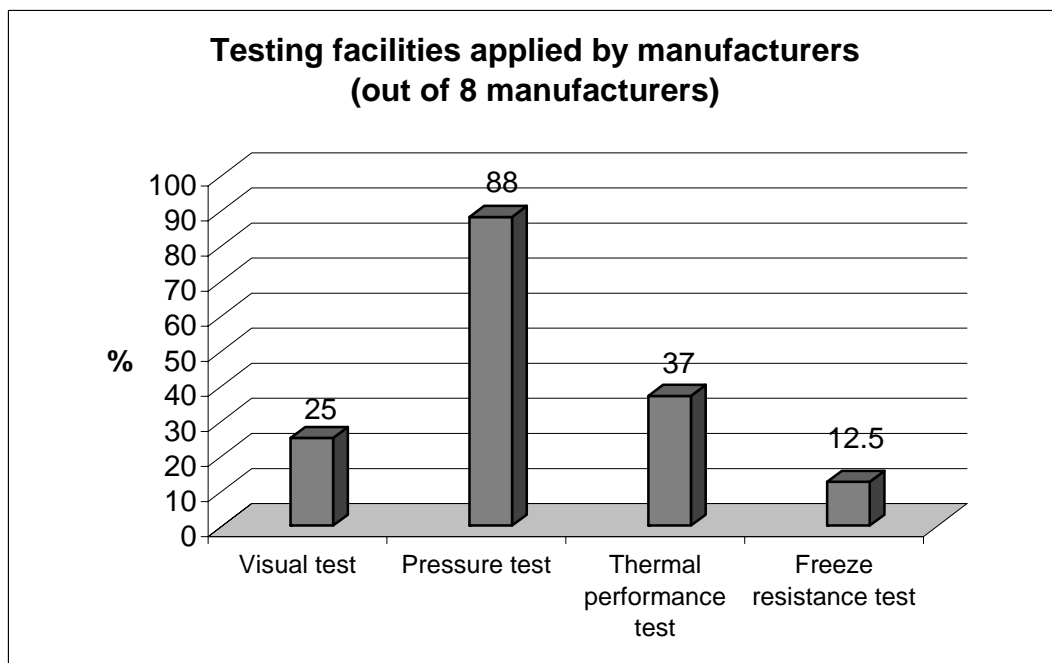
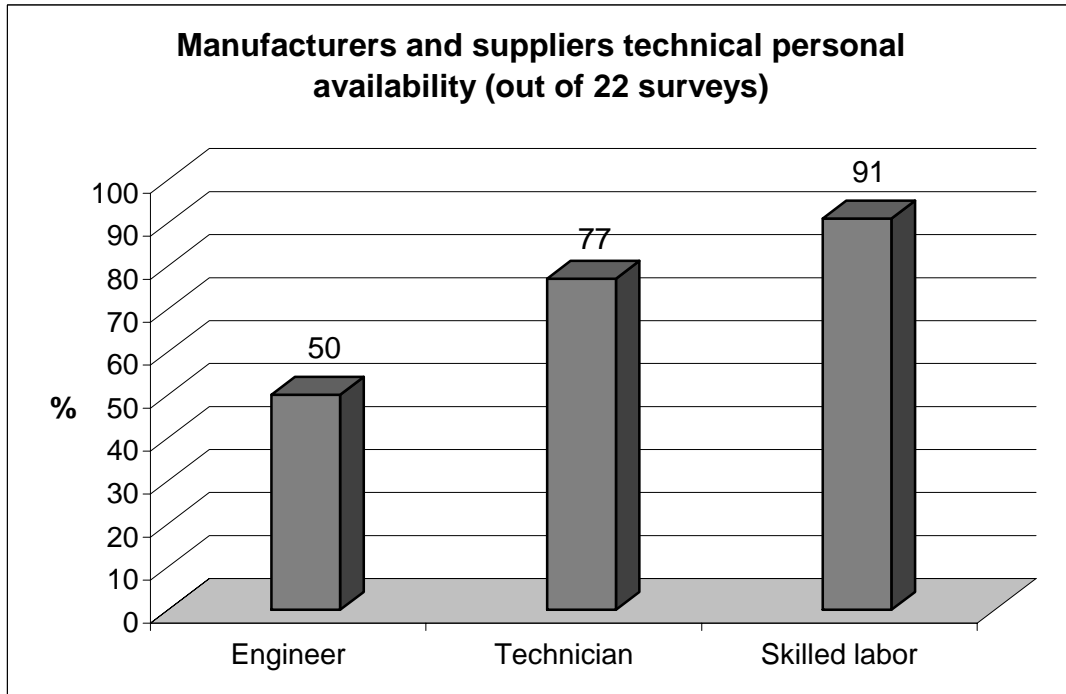
Company Name	Solar Collector		Solar Hot Water Tank	
	Brand Name	Origin	Brand Name	Origin
Adel Bou Habib & Co	De Dietrich	France	De Dietrich	France
Adib Bahnam	Viessmann	Germany	Viessman	Germany
Al-Bina	Maltezos Sunpower	Greece Greece	Maltezos Sunpower	Greece Greece
Aquatherma Engineering	Solarite	Turkey	Solarite	Turkey
ATON	Istek	Turkey	Istek Sunfire	Turkey Lebanon
Dawtec	Kuzeysan	Turkey	Kuzeysan	Turkey
Debbas Entreprise	Geysol	Germany	-	-
Etablissement Kanaan for trading (Solar Power)	Istek Oraset	Turkey Turkey	Istek	Turkey
Fakih	Fakih	Lebanon	Fakih	Lebanon
Falcon Win Trading	Falcon	Lebanon	Falcon	Lebanon
Ghaddar Trade & Industry (Sunfire)	Sunfire	Lebanon	Sunfire	Lebanon
Kypros	Kypros	Lebanon	Kypros	Lebanon
Middle East Scandenavian Marketing Office (Zreik)	Solaris	Turkey	-	Lebanon
RAY Solar Energy	Liu Piping	China	Liu Piping	China
Saadeddine	Special	Lebanon	Special	Lebanon
Siemens	Siemens	Athens	Siemens	Athens
Sky Energies	Giordano Novasol - Autumn	France Greece China Australia	-	Turkey
Solarhart	EZinc Solar hart	Turkey Australia	EZinc Solar hart	Turkey Australia
Solarnet	Solarnet	Lebanon	Solarnet	Lebanon
Sunco (ex Lseco)	Sunco	Lebanon	Sunco	Lebanon
Tfaily Solar Energy (Sunshine)	Sunshine	Lebanon	Sunshine	Lebanon
WEBCO/CESL division	-	Greece	Charot Flamco	France Holland

APPENDIX 7

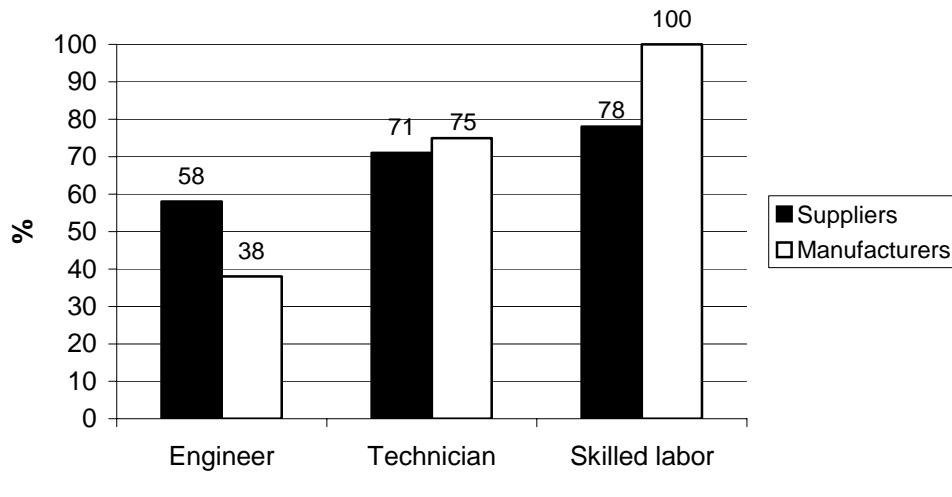
Level of Technicalities

Level of technicalities

On total, we have 22 surveys that include 14 suppliers and 8 manufacturers.



**Comparison between manufacturers and suppliers
technical personal availability
(out of 8 manufacturers & 14 suppliers)**



APPENDIX 8

Installed solar capacities

Installed capacities (raw values)

Companie Name	Solar collector m2 per year that can be locally produced	Solar collector m2 per year really installed				
		2005 (forecast)	2004	2003	2002	2001
SUPPLIERS						
Adel Bou Habib & Co						
Al Bina		320	400	400	200	0
Aquatherma Engineering						
ATON		20	30	0	0	0
Solar power (Kanaan)						
Zreik		800				600
RAY Solar Energy			120			
Siemens			48			
Sky Energies						
Solarhart			120			
CESL		0	0	200	200	200
Adib Bahnam						
Debbas Entreprise		0	0	216	70	165
Dawtec		600	400	100	0	0
SUB TOTAL Suppliers		1740	1118	916	470	965
MANUFACTURERS						
Falcon Win Trading	5100	1600	1450	1300	1200	1050
Sunfire	5000	3500	3000	1500	1300	1200
Kypros	6000		400			
Solar Net	800	1000	800	300	100	0
Sunshine (Tfaily)	6500	3500	2500	1800	1300	1000
Saadeddine Denniye						
Soley Fakih						
SUNCO (Lseco)						
Sub total Manufacturers	23400	9600	8150	4900	3900	3250
Total Suppliers +manufacturers	23400	11340	9268	5816	4370	4215

Installed capacities (extrapolated & corrected values)

Companie Name	Solar collector m2 per year that can be locally produced	Solar collector m2 per year really installed					Estimation prior to 2001**
		2005 (forecast)	2004	2003	2002	2001	
SUPPLIERS							
Adel Bou Habib & Co		50	50	0	0	0	
Al Bina		320	400	400	200	0	
Aquatherma Engineering		800	600	500	400	300	
ATON		20	30	0	0	0	
Solar power (Kanaan)		800	600	500	400	300	
Zreik		800	600	600	600	600	
RAY Solar Energy		120	120	0	0	0	
Siemens		48	48	60	100	100	
Sky Energies		1000	800	700	700	600	
Solarhart		40	120	80	80	80	
CESL		0	0	200	200	200	
Adib Bahnam		50	50	0	0	0	
Debbas Entreprise		0	0	216	70	165	
Dawtec		600	400	100	0	0	
SUB TOTAL Suppliers		4648	3818	3356	2750	2345	11000
MANUFACTURERS							
Falcon Win Trading	5100	1600	1450	1300	1200	1050	
Sunfire	5000	3500	3000	1500	1300	1200	
Kypros	6000	600	400	400	400	300	
Solar Net	6000	1000	800	300	100	0	
Sunshine (Tfaily)	6500	3500	2500	1800	1300	1000	
Saadeddine Denniye	5000	800	400	200	0	0	
Soley Fakih	5000	600	600	600	600	600	
Sunco (Lseco)	5000	600	600	600	600	600	
Sub total Manufacturers	43600	12200	9750	6700	5500	4750	40000
Total Suppliers +manufacturers:	43600	16848	13568	10056	8250	7095	51000

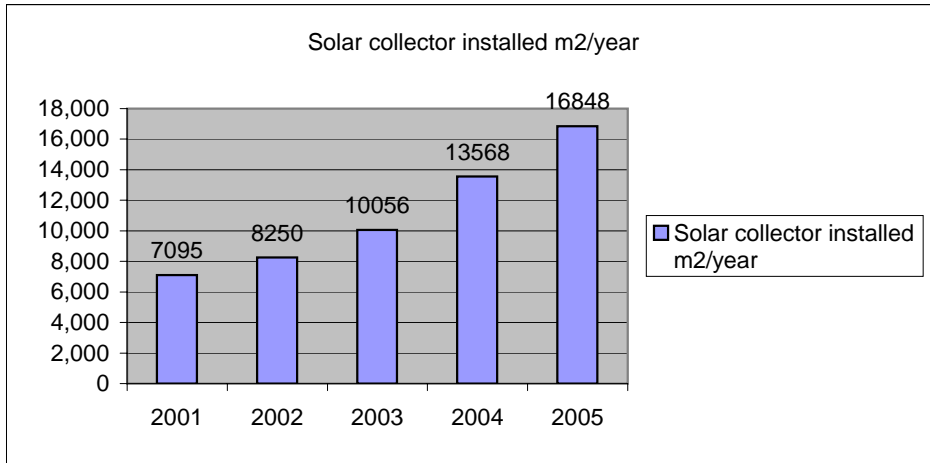
** Estimation prior to 2001 are calculated based on average of 5000 m2 per year on 10 years; from 1991 up to 2000

Solar thermal energy ratios

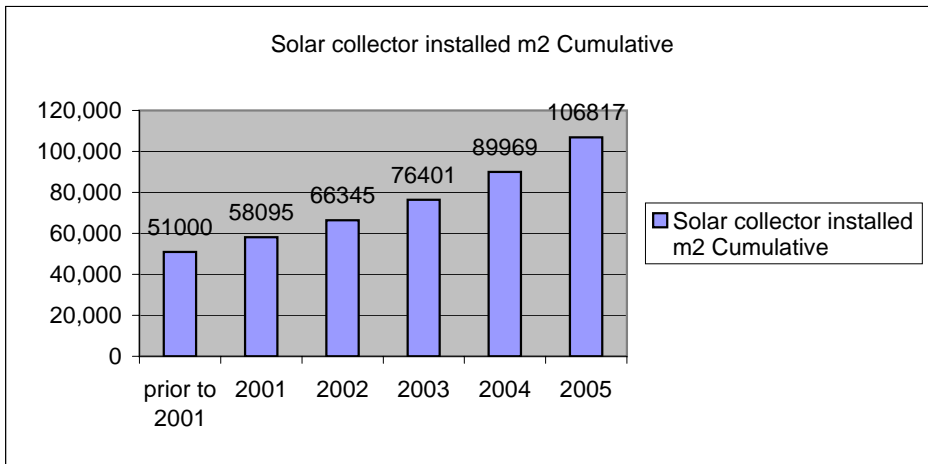
Description	Maximum production capacity per year	Installed capacities					Estimation prior to 2001
		2005 (forecast)	2004	2003	2002	2001	
Solar collectors m ² /year		16848	13568	10056	8250	7095	
Solar collectors that are installed cumulative (m ²)		106817	89969	76401	66345	58095	51000
Number of inhabitants(per thousands)		4140	4059	3979	3901	3825	3750
m ² installed per thousands inhabitants(yearly)		4.1	3.3	2.5	2.1	1.9	
m ² installed per thousands inhabitants(cumulative)		25.8	22.2	19.2	17.0	15.2	13.6
MWh produced (yearly)		15374	12381	9176	7528	6474	
MWh produced (cumulative)		97471	82097	69716	60540	53012	46538
Eliminated Tons of CO ₂ (yearly)		12299	9905	7341	6023	5179	
Eliminated Tons of CO ₂ (cumulative)		77976	65677	55773	48432	42409	37230
Diesel oil equivalent energy price \$/KWh (including heat production system efficiency)		0.07	0.06	0.05	0.04	0.04	0.03
Quantity of currency saved (yearly) USD		\$1,076,166	\$742,848	\$458,805	\$301,125	\$258,968	
Quantity of currency saved (cumulative) MUSD		\$6,822,936	\$4,925,803	\$3,485,796	\$2,421,593	\$2,120,468	\$1,396,125

ASSUMPTIONS

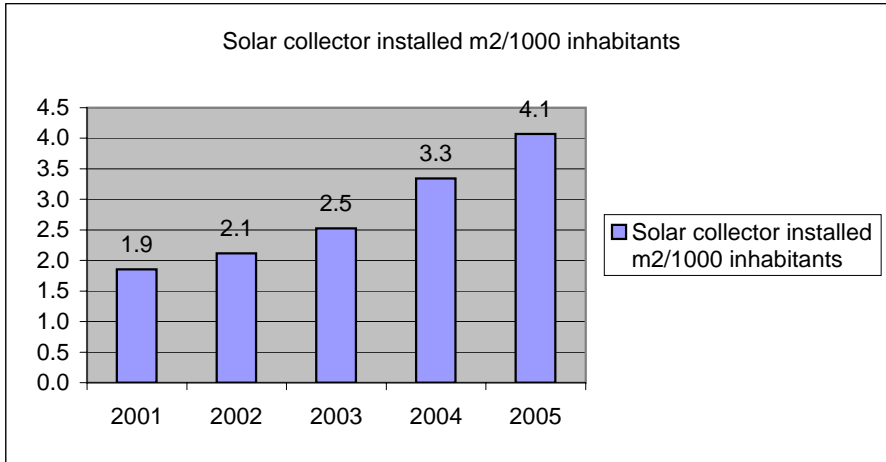
Average yearly solar Energy radiation received in Lebanon MWh/m ²	1.825
Maximum instantaneous energy received in Lebanon in Watts	900
Average panel efficiency	50%
1 Mwh equivalent Tons of CO ₂ rejected	0.8



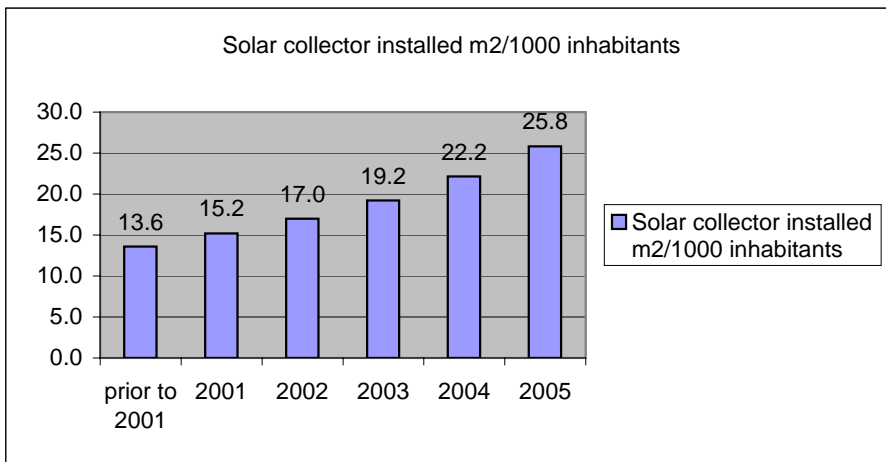
yearly	2001	2002	2003	2004	2005
Solar collector installed m2/year	7095	8250	10056	13568	16848



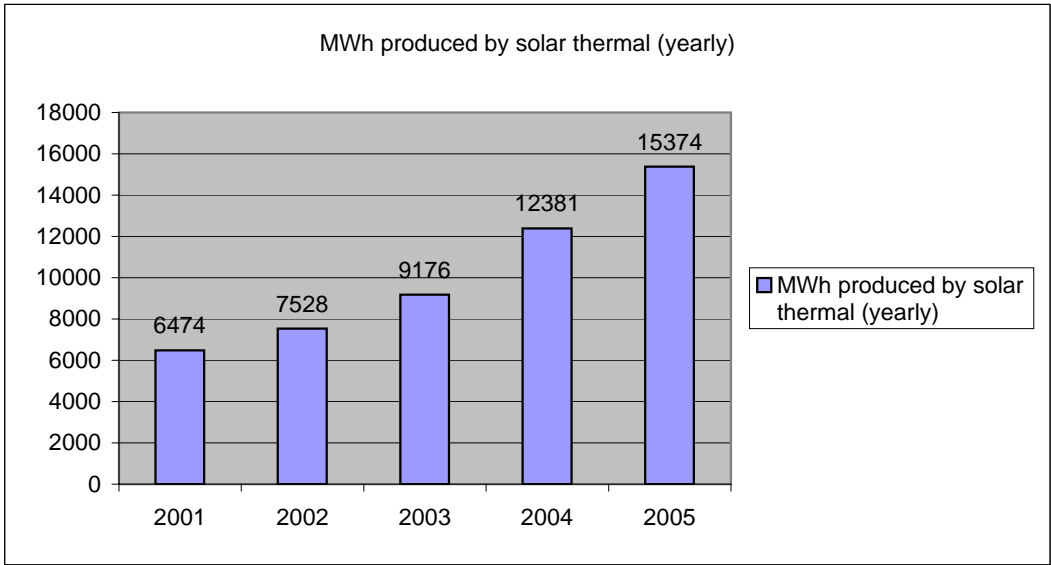
Cumulative	prior to 2001	2001	2002	2003	2004	2005
Solar collector installed m2 Cumulative	51000	58095	66345	76401	89969	106817



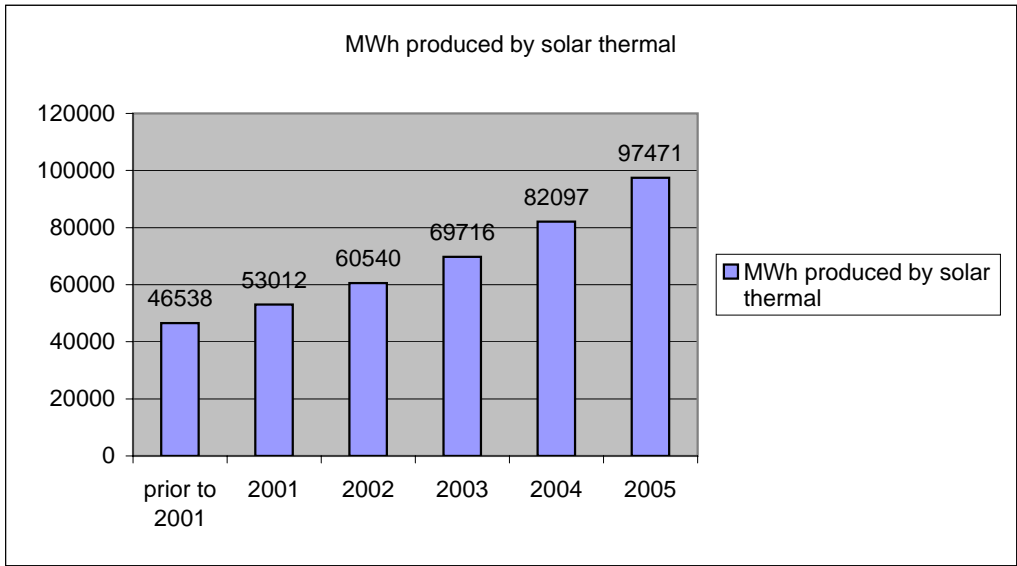
yearly	2001	2002	2003	2004	2005
Solar collector installed m2/1000 inhabitants	1.9	2.1	2.5	3.3	4.1



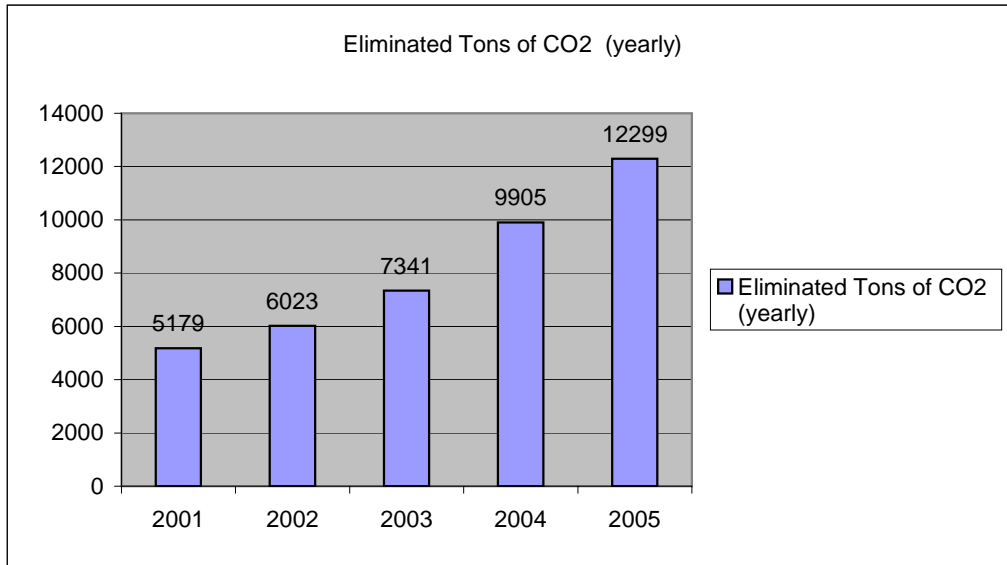
cumulative	prior to 2001	2001	2002	2003	2004	2005
Solar collector installed m2/1000 inhabitants	13.6	15.2	17.0	19.2	22.2	25.8



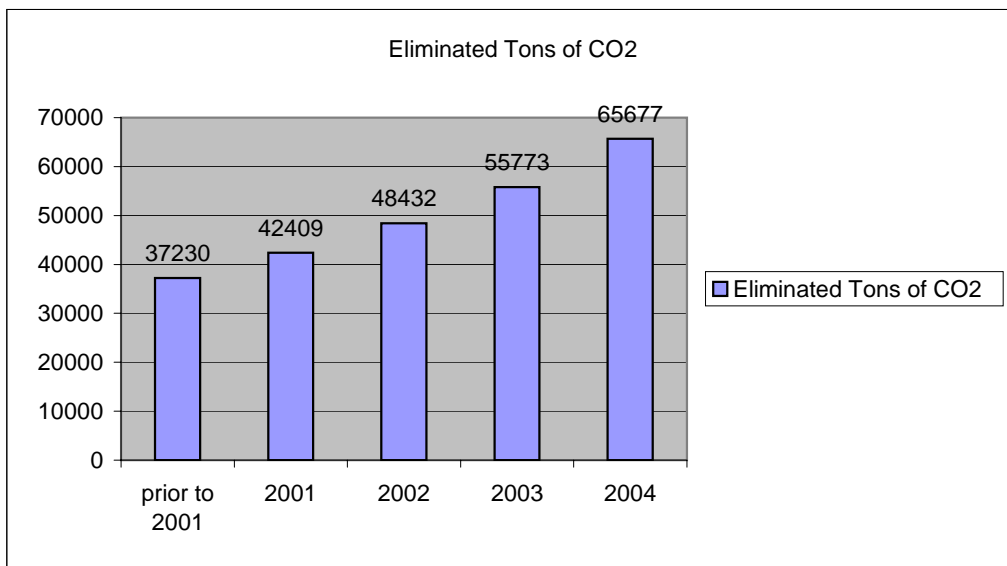
yearly	2001	2002	2003	2004	2005
MWh produced by solar thermal (yearly)	6474	7528	9176	12381	15374



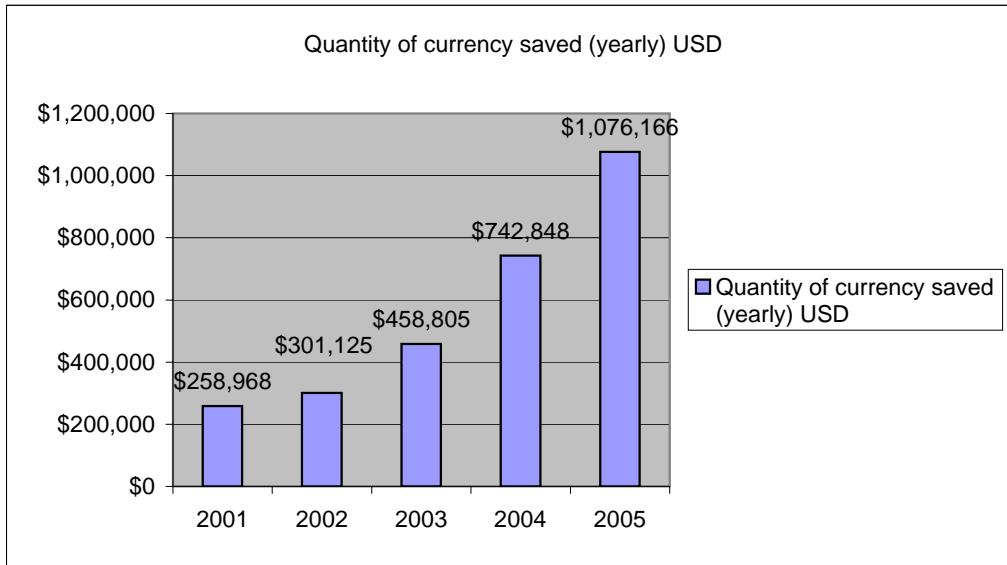
Cumulative	prior to 2001	2001	2002	2003	2004	2005
MWh produced by solar thermal	46538	53012	60540	69716	82097	97471



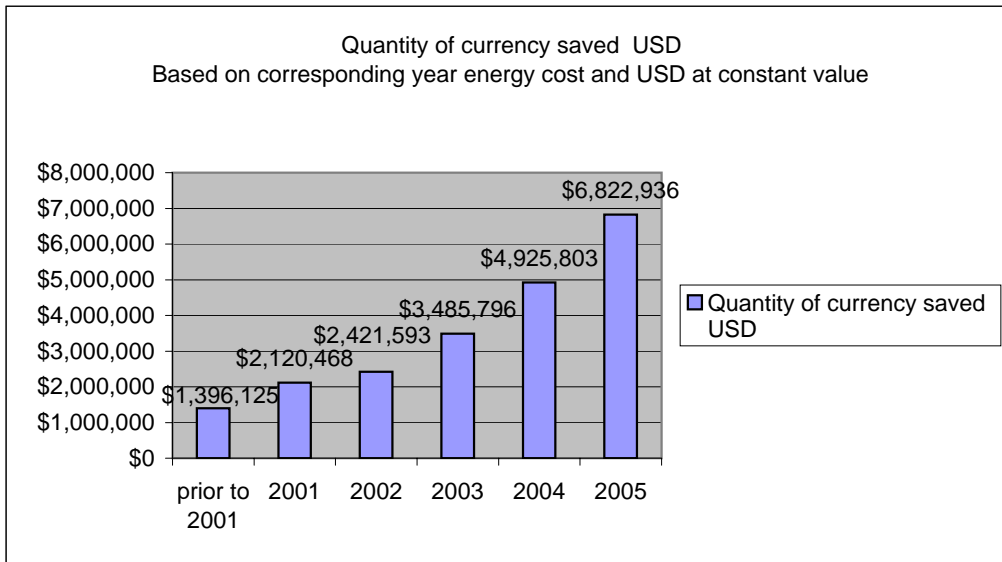
	2001	2002	2003	2004	2005
Eliminated Tons of CO2 (yearly)	5179	6023	7341	9905	12299



	prior to 2001	2001	2002	2003	2004	2005
Eliminated Tons of CO2	37230	42409	48432	55773	65677	77976

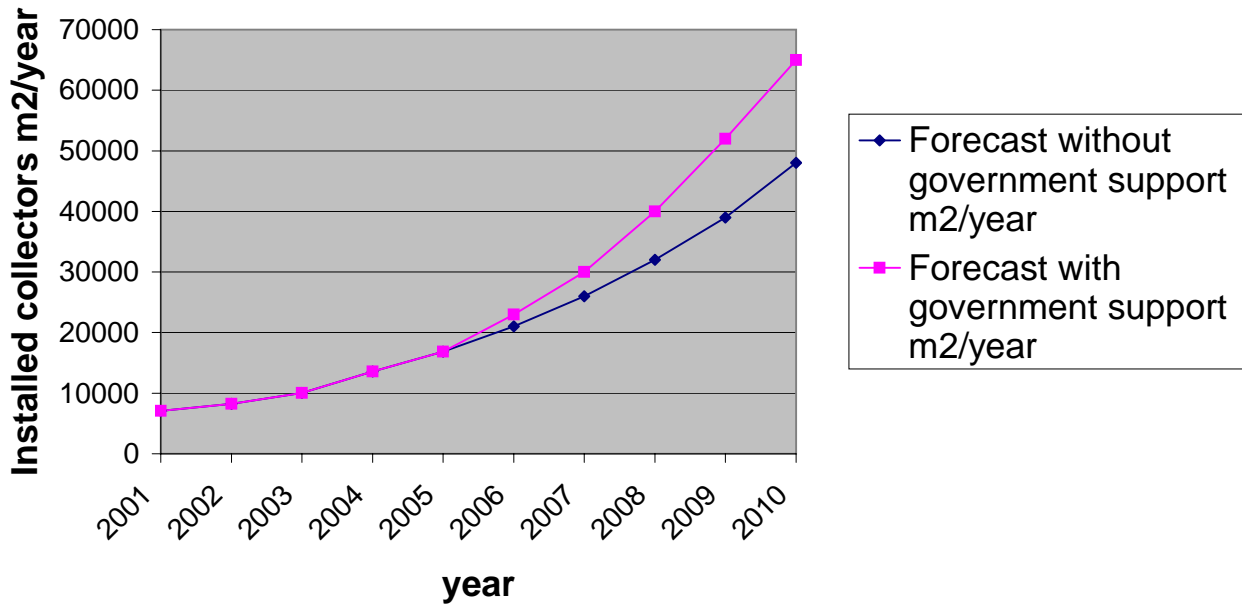


	2001	2002	2003	2004	2005
Quantity of currency saved (yearly) USD	\$258,968	\$301,125	\$458,805	\$742,848	\$1,076,166



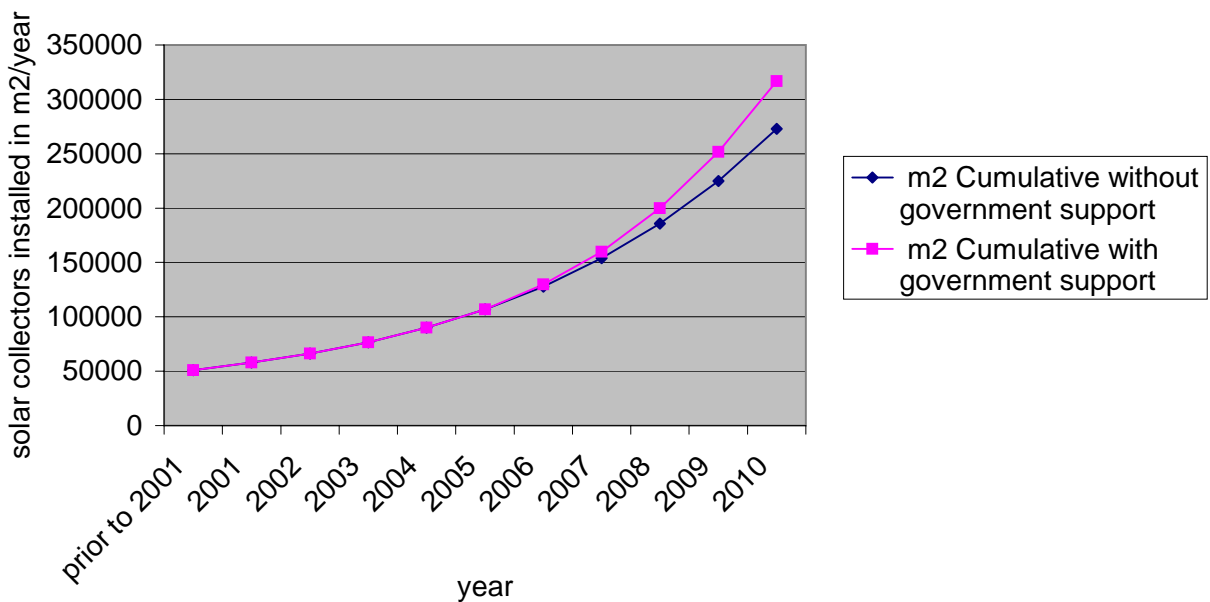
	prior to 2001	2001	2002	2003	2004	2005
Quantity of currency saved USD	\$1,396,125	\$2,120,468	\$2,421,593	\$3,485,796	\$4,925,803	\$6,822,936

Installed solar collector m2 forecast scenarios



yearly	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Forecast without government support m2/year	7095	8250	10056	13568	16848	21000	26000	32000	39000	48000
Forecast with government support m2/year	7095	8250	10056	13568	16848	23000	30000	40000	52000	65000

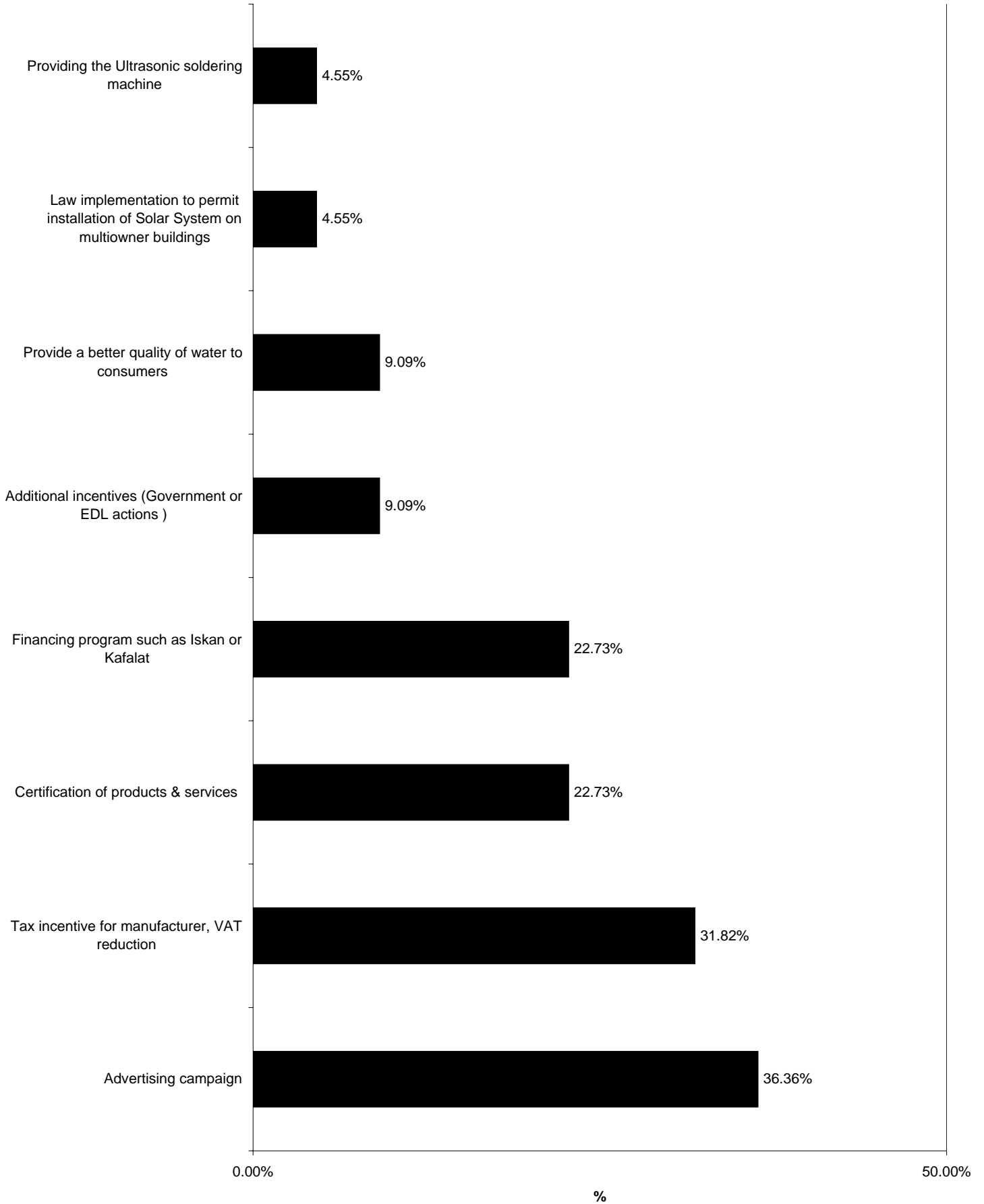
Solar collectors installed in m2 (cumulative forecast scenarios)



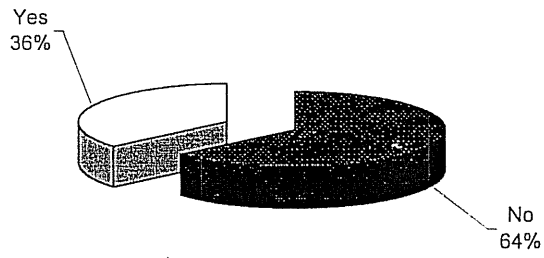
Cumulative	prior to 2001	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
m2 Cumulative without government support	51000	58095	66345	76401	89969	106817	127817	153817	185817	224817	272817
m2 Cumulative with government support	51000	58095	66345	76401	89969	106817	129817	159817	199817	251817	316817

APPENDIX 9
Problems and Solutions

Solutions to increase use of solar systems in Lebanon



Did you hear about the project of Energy Efficiency with UNDP?



Did you hear about UNDP project?	%
No	64
Yes	36

APPENDIX 10
Cost assessment of solar equipment in the market

COST ASSESSMENT

LOW COST SYSTEMS

Locally made or imported solar systems with poor quality product and low installation specifications
Flat plate collectors or evacuated tubes

solar system description	Investment cost in USD **	Yearly saving compared to electricity in USD	Yearly saving compared to fuel in USD	Payback period compared to electricity in years	Payback period compared to fuel in years	Average solar system life duration in years
200 liters thermosiphonic solar system, open type, including installation, plumbing piping and accessories	\$600	\$270	\$200	2.2	3.0	4***
300 liters thermosiphonic solar system, open type, including installation, plumbing piping and accessories	\$900	\$600	\$300	1.5	3.0	4***
200 liters thermosiphonic solar system, closed type, including installation, plumbing piping and accessories	\$1,000	\$400	\$200	2.5	5.0	15
300 liters thermosiphonic solar system, closed type, including installation, plumbing piping and accessories	\$1,300	\$600	\$300	2.2	4.3	15
200 liters forced circulation solar system, closed type, including installation, plumbing piping, pumps controller and accessories	\$1,300	\$400	\$200	3.3	6.5	15
300 liters forced circulation solar system, closed type, including installation, plumbing piping, pumps controller and accessories	\$1,600	\$600	\$300	2.7	5.3	15

** Investment cost includes solar system equipment, installation, piping and accessories, pumps and controller (forced circulation only), and all required standard works. Any special works required by clients are not included in such cost.

*** Hard water in Lebanon makes life time of open circuit very short

COST ASSESSMENT

AVERAGE COST SYSTEMS

Locally made or imported solar systems with standard quality product and good installation specifications
Flat plate collectors or evacuated tubes

solar system description	Investment cost in USD**	Yearly saving compared to electricity in USD	Yearly saving compared to fuel in USD	Payback period compared to electricity in years	Payback period compared to fuel in years	Average solar system life duration in years
200 liters thermosiphonic solar system , open type, including installation, plumbing piping and accessories	\$900	\$400	\$300	2.3	3.0	4***
300 liters thermosiphonic solar system , open type, including installation, plumbing piping and accessories	\$1,200	\$600	\$400	2.0	3.0	4***
200 liters thermosiphonic solar system , closed type, including installation, plumbing piping and accessories	\$1,300	\$400	\$300	3.3	4.3	20
300 liters thermosiphonic solar system , closed type, including installation, plumbing piping and accessories	\$1,600	\$600	\$400	2.7	4.0	20
200 liters forced circulation solar system , closed type, including installation, plumbing piping , pumps controller and accessories	\$1,600	\$400	\$300	4.0	5.3	20
300 liters forced circulation solar system , closed type, including installation, plumbing piping , pumps controller and accessories	\$1,900	\$600	\$400	3.2	4.8	20

** Investment cost includes solar system equipment , installation, piping and accessories, pumps and controller (forced circulation only), and all required standard works. Any special works required by clients are not included in such cost.

*** Hard water in Lebanon makes life time of open circuit very short

COST ASSESSMENT

HIGH COST SYSTEMS

Mainly imported solar systems with high quality product and good installation specifications
Flat plate collectors or evacuated tubes

solar system description	Investment cost in USD**	Yearly saving compared to electricity in USD	Yearly saving compared to fuel in USD	Payback period compared to electricity in years	Payback period compared to fuel in years	Average solar system life duration in years
200 liters thermosiphonic solar system, open type, including installation, plumbing piping and accessories		Not manufactured				
300 liters thermosiphonic solar system, open type, including installation, plumbing piping and accessories		Not manufactured				
200 liters thermosiphonic solar system, closed type, including installation, plumbing piping and accessories	\$1,900	\$450	\$320	4.2	5.9	25
300 liters thermosiphonic solar system, closed type, including installation, plumbing piping and accessories	\$2,300	\$700	\$430	3.3	5.3	25
200 liters forced circulation solar system, closed type, including installation, plumbing piping, pumps controller and accessories	\$2,300	\$450	\$320	5.1	7.2	25
300 liters forced circulation solar system, closed type, including installation, plumbing piping, pumps controller and accessories	\$2,800	\$700	\$430	4.0	6.5	25

** Investment cost includes solar system equipment, installation, piping and accessories, pumps and controller (forced circulation only), and all required standard works. Any special works required by clients are not included in such cost.

APPENDIX 12
Comparison with international markets

**COMPARISON WITH SIMILAR THERMAL SOLAR SYSTEMS
FOUND ON THE INTERNATIONAL MARKET
QUANTITATIVE COMPARISON**

THERMAL SOLAR SYSTEMS TYPE AND APPLICATIONS	LEBANON	CYPRUS*	GREECE*	AUSTRIA*	GERMANY*	SPAIN*	FRANCE*	DENMARK*	NETHERLANDS*	INDIA*	CHINA*
Total installed collectors in M2	106,000	480,000	3,200,000	2,400,000	6,800,000	570,000	350,000	405,000	300,000	1,000,000	60,000,000
population number	4,100,000	780,100	10,600,000	8,000,000	84,000,000	40,000,000	61,000,000	5,400,000	16,400,000	1,000,000,000	1,300,000,000
Solar collector M2/1000 capita	26	615	302	300	81	14	6	75	18	1	46
2005 growth from 2004	24%	8%	34%	9%	12%	15%	30%	***	1%	***	28%

THERMAL SOLAR SYSTEMS TYPE AND APPLICATIONS	TUNISIA**	EGYPT**	JORDAN**	MOROCCO**
Total installed collectors in M2	100,000	150,000	1,100,000	200,000
population number	10,000,000	79,000,000	5,800,000	33,200,000
Solar collector M2/1000 capita	10	2	190	6
2005 growth from 2004	***	***	***	***

*: Renewable Energy World sources
 **: ADEME sources
 ***: Not Available Information

**COMPARISON WITH SIMILAR THERMAL SOLAR SYSTEMS
FOUND ON THE INTERNATIONAL MARKET**

THERMAL SOLAR SYSTEMS TYPE AND APPLICATIONS	LEBANON	NEAR EAST ARAB COUNTRIES	MAGHREB COUNTRIES	SOUTHERN EUROPE COUNTRIES	NORTHERN EUROPE COUNTRIES	NORTH AMERICA & AUSTRALIA	CHINA
SOLAR COLLECTORS							
Flat plate	A	A	A	A	A	A	C
Evacuated tubes	C	D	D	D	C	D	A
Unglazed or black epdm matress for pool	D	D	D	B	B	A	D
Integral collector-storage system	D	D	D	D	D	D	D
HOT WATER TANKS							
Up to 200 liters	A	A	A	A	A	A	A
Between 201 & 300 liters	A	A	A	A	A	A	A
Between 301 & 400 liters	B	B	B	A	A	A	C
Between 401 & 500 liters	B	B	B	A	A	A	C
Above 501 liters	C	C	B	A	A	A	C
COMPLETE FACTORY MADE SYSTEM							
Thermosiphon for hot water Closed circuit	A	A	A	A	C	A	A
Thermosiphon for hot water open circuit	A	A	B	B	C	B	A
Integral collector-storage system	D	D	D	D	D	D	D
Package forced circulation system	D	D	D	C	B	C	D
APPLICATION TYPE							
Thermosiphon for hot water	A	A	A	A	C	A	A
Integral collector-storage hot water system	D	D	D	D	D	D	D
Forced circulation for hot water	B	B	B	B	A	A	B
Forced circulation for pool heating	C	C	C	B	B	A	D
Forced circulation for space heating	D	D	D	C	B	B	D
APPLICATION SIZE							
Less than 6 m2 solar collectors	A	A	A	A	A	A	A
Between 7m2 and 20 m2	B	B	B	A	A	A	A
Between 21m2 and 100 m2	C	C	B	A	A	A	A
Above 100 m2	C	C	B	A	A	A	A
USERS							
Residential buildings	C	C	C	B	B	C	A
Residential individual	A	A	A	A	A	A	A
Retails	C	C	C	C	C	C	C
Large commercial (hotels ,hospitals)	C	C	B	B	B	B	A
Industrial	D	D	D	B	B	C	C
MARKET PENETRATION LEVEL	A	MAJOR SMALL	PENETRATION PENETRATION	PENETRATION	B	NORMAL RARE/ INEXISTING	PENETRATION PENETRATION
	C				D		

Notes:

- 1- Evaluation criteria is based on the present survey for Lebanon and on specialized magazines reports for all the other countries.(since no clear market studies is available)
- 2- This comparison does not include the solar thermal collectors concentration (m2/1000 inhabitants) with other countries. It only applies to product availability, application, and user type.