WERNER WEISS | FRANZ MAUTHNER

SOLAR HEAT WORLDWIDE

Markets and Contribution to the Energy Supply 2008

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

2010
EDITION

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1 Background

This report was prepared within the framework of the Solar Heating and Cooling Programme (SHC) of the International Energy Agency (IEA). The goal of the report is to document the solar thermal capacity previously installed in the important markets worldwide, and to ascertain the contribution of solar thermal systems to the supply of energy and the CO_2 emissions avoided as a result of operating these systems. The collectors documented are unglazed collectors, glazed flat-plate and evacuated tube collectors with water as the energy carrier as well as glazed and unglazed air collectors.

The data were collected from a questionnaire survey of the national delegates of the SHC Programme's Executive Committee and other national experts active in the field of solar thermal energy. Since some of the 53 countries included in this report have very detailed statistics and others could only provide estimates from experts, the data was checked for its plausibility on the basis of various publications.

Starting with the collector area respectively the capacity installed, the contributions of solar thermal systems towards the supply of energy and the reduction of CO_2 were ascertained.

The 53 countries included in this report represent 4.1 billion people, which is about 61% of the world's population. The installed capacity in these countries is estimated to represent 85–90% of the solar thermal market worldwide.

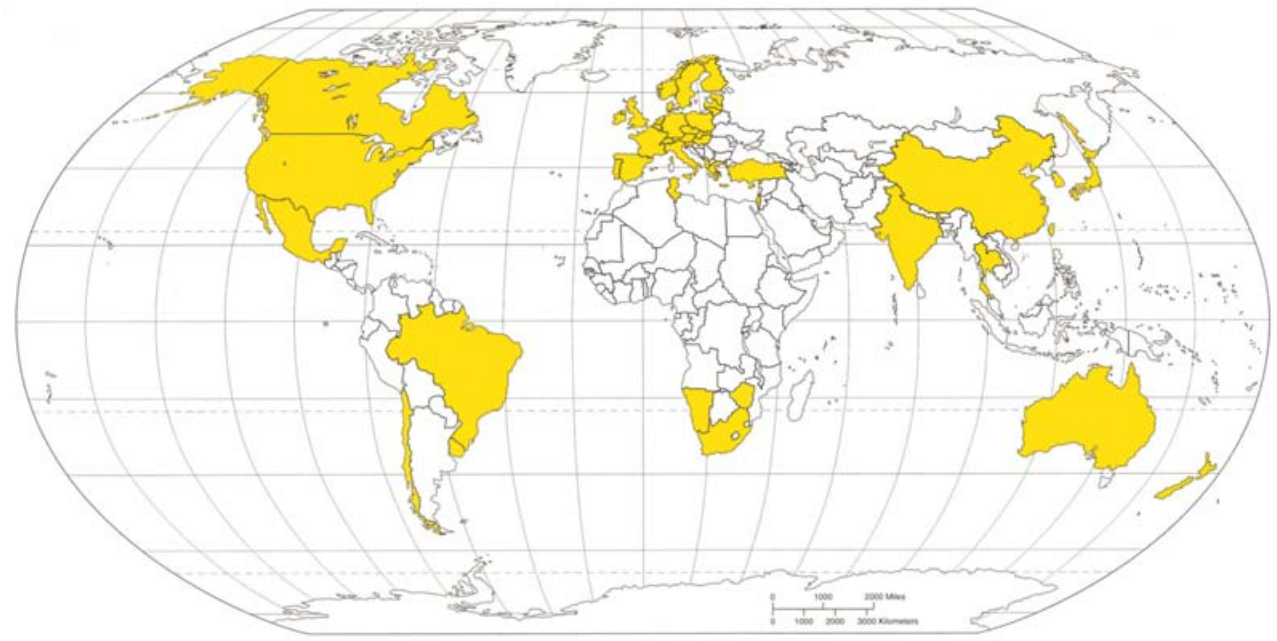


Figure 1: Countries represented in this report

2 Summary

Solar Thermal Capacity in Operation Worldwide

The solar thermal collector capacity in operation worldwide equaled 151.7 GW_{th} corresponding to 217.0 million square meters[1] by the end of the year 2008. Of this, 131.8 GW_{th} were accounted for by flat-plate and evacuated tube collectors and 18.9 GW_{th} for unglazed plastic collectors. Air collector capacity was installed to an extent of 1.2 GW_{th}.

The main markets are in China (87.5 GW_{th}), Europe (28.5 GW_{th}), and the United States and Canada (15.1 GW_{th}) which together account for 86.3% of the total installations. The rest of the market is shared between Japan (4.42 GW_{th}), Australia and New Zealand (4.36 GW_{th}), some Asian countries (4.02 GW_{th}), Central and South American countries (3.8 GW_{th}), the Middle East represented by Israel and Jordan (3.29 GW_{th}) and some African countries (0.9 GW_{th}).

Distribution by Application

The use of solar thermal energy varies greatly in the different countries. In China, Europe and Japan, the dominant systems are flat-plate and evacuated tube collectors, which are primarily used to prepare hot water and to provide space heating. In other large markets, such as the United States and Australia, unglazed plastic absorbers for swimming pool heating are the dominant application.

The dominant collector type is the vacuum tube collector, which represents 54.2% of the global market, followed by the flat-plate collector with a market share of 32.6%. Unglazed plastic collectors account for 12.4% of the market and air collectors represent the smallest share with 0.8%.

Besides China and Jordan, where evacuated tube collectors dominate the market, in all the other documented countries the flat plate collector remains the dominant collector type. However, there is a notable trend in the growing market share of evacuated tube collectors in Germany, Italy, Poland, the United States, the United Kingdom and Spain. And, in South Africa and Sweden evacuated tube collectors have nearly reached similar market shares to flat plate collectors.

Another distinction that can be made pertains to pumped solar systems and thermosiphon systems. In the United States, Europe and Australia pumped solar thermal systems are primarily installed. In other large markets, namely in Japan, Brazil and China, thermosiphon systems are predominant.

Europe has the most sophisticated market for offering a diverse selection of solar thermal applications. It includes systems for hot water preparation, plants for space heating of single- and multi-family houses and hotels, large-scale plants for district heating as well as a growing number of systems for industrial applications and for air conditioning and cooling.

There are about 150 large-scale plants (≥ 500 m²; 350 kW_{th}) in operation in Europe with a total installed capacity of 160 MW_{th}. The biggest plants for solar assisted district heating are located in Denmark with 13 MW_{th} (18,300 m²) and Sweden with 7 MW_{th} (10,000 m²). The largest reported solar thermal system for industrial process heat was installed in 2007 in China. The 9 MW_{th} (13,000 m²) plant produces heat for a textile company.

Leading Countries

Flat-plate and evacuated tube collectors

In terms of the total capacity in operation of flat-plate and evacuated tube collectors at the end of the year 2008, China (87.5 GW_{th}), Turkey (7.5 GW_{th}), Germany (7.2 GW_{th}), Japan (4.1 GW_{th}) and Greece (2.7 GW_{th}) are the leading

1 Making the installed capacity of solar thermal collectors comparable with that of other energy sources, solar thermal experts from seven countries agreed upon a methodology to convert installed collector area into solar thermal capacity at a joint meeting of the IEA SHC Programme and major solar thermal trade associations held September 2004 in Gleisdorf, Austria. The represented associations from Austria, Canada, Germany, the Netherlands, Sweden and United States as well as the European Solar Thermal Industry Federation (ESTIF) and the IEA SHC Programme agreed to use a factor of 0.7 kW_{th}/m^2 to derive the nominal capacity from the area of installed collectors.

countries. They are followed by Israel (2.6 GW_{th}), Brazil (2.4 GW_{th}), Austria (2.3 GW_{th}), the United States (1.9 GW_{th}) and India (1.8 GW_{th}).

China is by far the largest market, representing 66.4% of the world market for flat-plate and evacuated tube collectors.

In terms of market penetration, based on the total capacity in operation per 1,000 inhabitants, Cyprus (527.2 kW_{th}), Israel (371.3 kW_{th}), Austria (285.0 kW_{th}), Greece (252.6 kW_{th}) and Barbados (202.7 kW_{th}) are the leading countries. They are followed by Jordan (101.9 kW_{th}), Turkey (98.2 kW_{th}), Germany (87.7 kW_{th}), Australia (66.6 kW_{th}) and China (66.4 kW_{th}).

Unglazed plastic collectors

With regard to the heating of swimming pools with unglazed plastic collectors, the United States lead with a total capacity of 12.4 GW_{th} in operation ahead of Australia with 2.9 GW_{th}, Brazil with 0.6 GW_{th}, Germany, Canada and South Africa with around 0.5 GW_{th} each, and Austria with 0.4 GW_{th}.

The market penetration gives a slightly different picture—Australia leads in installed capacity per 1,000 inhabitants with 136.6 kW_{th} ahead of Austria with 53.2 kW_{th} and the United States with 40.8 kW_{th}. In fourth to sixth place are Switzerland, Canada and the Netherlands with installed capacities between 20 and 15 kW_{th} per 1,000 inhabitants.

Installed Capacity in 2008

In the year 2008, a new capacity of 29.1 GW_{th} corresponding to 41.5 million square meters of solar collectors was installed worldwide. The overall new installations grew by 34.9% compared to 2007. This represents a significant increase in the growth rate compared to 2006 / 2007 were the market grew only 18.8%. The main reasons for this growth were the high growth rates of glazed water collectors in China (+ 34.8%), Europe (+ 62.5%) and in the United States (+ 41.8%).

The share of glazed water collectors (flat-plate and evacuated tube) accounted for 27.5 GW_{th} or 94.6% of the overall installations.

The global market for evacuated tube and flat plate collectors shows a steady rate of high growth, 35.4% and 42.7% respectively compared to the year 2007. Also, there was a significant increase in the market for unglazed air collectors (+ 183.2%). The main reason for this was the installation of 23.9 MW_{th} of new installations in Canada.

The most dynamic markets for water collectors (unglazed, glazed flat-plate and evacuated tube collectors) in 2008 were in some European countries. Compared to the capacity installed in 2007, Belgium increased its capacity in 2008 by 79%, Cyprus by 158%, Germany by 116%, Ireland by 122%, Macedonia by 105%, Poland by 90% and Slovenia by 115%.

Besides these European countries, the markets in Canada (128.5%), Jordan (344%), South Africa (71.8%) and Tunisia (100%) have recorded large growth rates.
New installations in China, the world's largest market, increased again significantly in 2008 by 34.8% compared to the year 2007. After a market decline in Japan in 2007 the growth rate was once again positive in 2008 (+ 21.9%).

Market decreases compared to 2007 were reported for Israel (-7%), the Slovak Republic (-47%) and Taiwan (-12.7%).

The main markets for unglazed water collectors are still found in the United States (0.8 GW_{th}), Australia (0.4 GW_{th}) and Brazil (0.08 GW_{th}). Notable markets are also in Austria, Canada, Mexico, The Netherlands, South Africa, Spain, Sweden and Switzerland with values between 0.07 and 0.01 GW_{th} of new installed unglazed water collectors in 2008.

Market development 2000 - 2008

The annually installed glazed water collector area worldwide 2008 was more than 4 times higher than in the year 2000 and was doubled between 2004 and 2008. The worldwide average annual growth rate between 2000 and 2008 was 20.1%

The worldwide market of unglazed collectors for swimming pool heating recorded an increase in 2000 and remained steady between 2001 and 2003. After a slight increase from 2004 to 2006 the installed capacity rate decreased again in 2007, mainly caused by the major market decline in the United States and Canada. In 2008, a growth was recorded in Central and South America, as well as in South Africa. All other markets remained quite stable.

Contribution of solar collectors to the supply of energy

The annual collector yield of all solar thermal systems in operation by the end of 2008 in the 53 recorded countries is 109,713 GWh (394,968 TJ). This corresponds to an oil equivalent of 12.4 million tons and an annual avoidance of 39.4 million tons of CO_2.

These values have been calculated from only the water-based systems. Air systems are excluded because the application database for air collectors is insufficient.

Employment

Based on data collected from detailed country reports, the jobs in the fields of production, installation and maintenance of solar thermal systems is estimated to be 260,000 worldwide.

Preview 2009

Based on the data available for the major markets in Europe, China and India at the date of publishing this report, the estimated total capacity in operation worldwide in 2009 is 189 GW_{th}, corresponding to 270 million square meters of collector area.

Compared with other forms of renewable energy, solar heating's contribution in meeting global energy demand is, besides the traditional renewable energies like biomass and hydropower, second only to wind power, and has a much larger contribution than photovoltaics (**Figure 2**). This fact is still underestimated in energy policies.

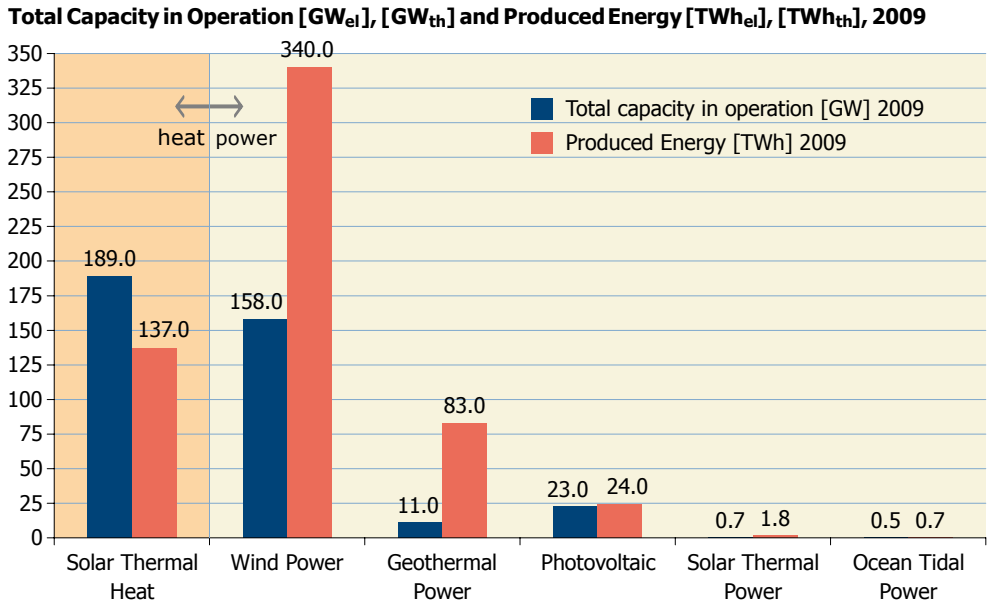


Figure 2: Total capacity in operation [GW_{el}], [GW_{th}] 2009 and annually energy generated [TWh_{el}], [TWh_{th}]. Sources: EPIA, GWEC, EWEA, EGEC, REN21 and IEA SHC 2009

3 Total capacity by the year 2008

This report aims to give the actual collector area that is in operation and not the cumulated collector area that has ever been installed in a country. To determine the collector area (and respectively capacity) in operation, either official country reports on the lifetime base were used or, if such reports were not available, a 25-year lifetime for a system was calculated. The collector area in operation was then calculated using a linear equation.

3.1 The main markets

Since the beginning of the 1990s, the solar thermal market has undergone a favorable development. At the end of 2008, a total of 217.0 million square meters of collector area, corresponding to an installed capacity 151.9 GW_{th} was in operation in the 53 countries recorded in this report. These 53 countries represent 4.17 billion people, which is 61% of the world's population. The installed capacity in these countries represents approximately 85–90% of the solar thermal market worldwide.
The main markets (glazed and unglazed water collectors as well as glazed and unglazed air collectors) are in China (87.5 GW_{th}), Europe (28.5 GW_{th}) and the United States and Canada (15.1 GW_{th}), which together account for 86.3% of the market share. The remaining share of the market is divided between Japan (4.42 GW_{th}), Australia and New Zealand (4.36 GW_{th}), some Asian countries (4.02 GW_{th}), Central and South America (3.8 GW_{th}), the Middle East represented by Israel and Jordan (3.29 GW_{th}) and some African countries (0.9 GW_{th}), namely Namibia, South Africa, Tunisia and Zimbabwe.

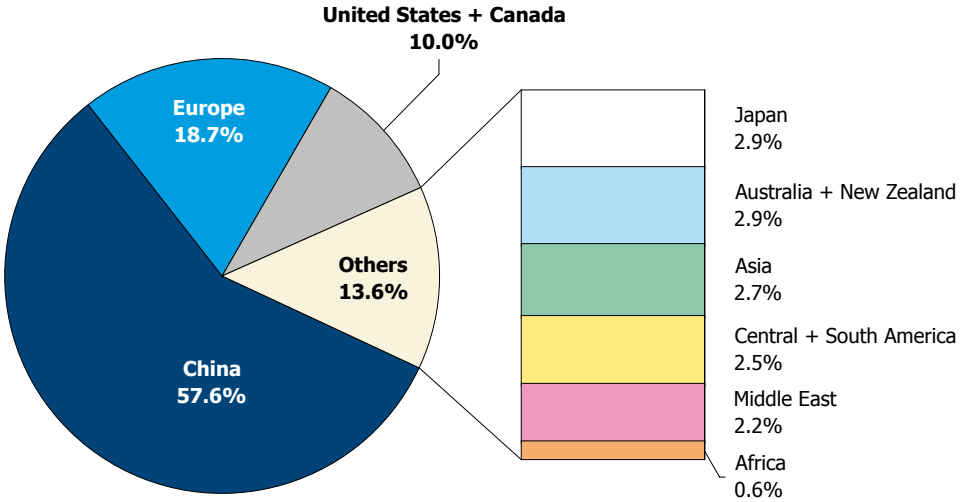


Figure 3: Share of the total collector installations (glazed and unglazed water and air collectors) by economic regions at the end of 2008

As shown in **Table 1** and **Table 2**, the total capacity is divided into 49.5 GW_{th} glazed flat-plate collectors (70.7 million square meters) and 82.3 GW_{th} evacuated tube collectors (117.6 million square meters), 18.8 GW_{th} unglazed collectors (26.9 million square meters) and 1.2 GW_{th} glazed and unglazed air collectors (1.7 million square meters).

ountry	Water Collectors*			Air Collectors*		TOTAL [MW_{th}]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		40.1	0.2			**40.3**
Australia	2,870.0	1,372.4	26.2			**4,268.6**
Austria	436.9	2,305.2	32.9			**2,775.0**
Barbados		57.5				**57.5**
Belgium	32.8	145.0	14.4			**192.2**
Brazil	562.0	2,443.3				**3,005.2**
Bulgaria		21.2				**21.2**
Canada	507.7	63.8	3.9	110.3	0.9	**686.6**
Chile	1.0	12.4				**13.4**
China		7,170.3	80,329.7			**87,500.0**
Cyprus		561.1	1.3			**562.5**
Czech Republic	10.2	83.1	16.1			**109.4**
Denmark	14.4	285.5	3.6	2.3	12.6	**318.4**
Estonia		1.3				**1.3**
Finland	8.2	16.3	0.8			**25.4**
France	70.2	1,214.0	22.2			**1,306.4**
Germany	504.0	6,507.7	715.0		23.5	**7,750.2**
Greece		2,709.0				**2,709.0**
Hungary	1.9	33.5	3.4			**38.8**
India		1,756.3	15.6		11.4	**1,783.3**
Ireland		39.9	13.3			**53.2**
Israel	18.7	2,641.0		0.3		**2,660.0**
Italy	17.7	840.0	174.7			**1,032.4**
Japan		4,040.4	71.1		309.3	**4,420.8**
Jordan		449.7	175.4			**625.1**
Korea		999.5				**999.5**
Latvia		4.8				**4.8**
Lithuania		2.9				**2.9**
Luxembourg		14.6	0.5			**15.1**
Macedonia		15.4	0.5			**15.9**
Malta		23.8				**23.8**
Mexico	347.6	376.2				**723.8**
Namibia		4.5	0.3			**4.7**
Netherlands	252.6	240.0				**492.6**
New Zealand	4.6	82.9	6.8			**94.2**
Norway	1.2	8.2	0.2		0.8	**10.5**
Poland	0.9	193.3	51.4	2.0	1.7	**249.3**
Portugal	0.9	238.5	8.5			**247.9**
Romania		52.1				**52.1**
Slovak Republic		67.4	7.7			**75.1**
Slovenia		83.1	2.8			**85.9**
South Africa	489.8	180.8	12.2			**682.8**
Spain	60.5	1,021.4	67.2			**1,149.1**
Sweden	73.5	164.5	28.7			**266.7**
Switzerland**	148.3	357.0	21.0	591.5		**1,117.7**
Taiwan	1.3	1,154.2	32.9			**1,188.4**
Thailand		53.7				**53.7**
Tunisia		195.9	4.4			**200.3**
IphaTurkey		7,445.8				**7,445.8**
United Kingdom		218.5	40.8			**259.3**
United States	12,409.0	1,477.3	430.2	0.1	113.5	**14,430.0**
Uruguay		3.4				**3.4**
Zimbabwe		12.1	0.02			**12.1**
TOTAL	**18,845.8**	**49,501.8**	**82,335.9**	**706.4**	**473.8**	**151,863.7**

* If no data is given: no reliable database for this collector type is available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 1: Total capacity in operation at the end of 2008 [MW_{th}]

Country	Water Collectors*			Air Collectors*		TOTAL [m²]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		57,283	336			**57,619**
Australia	4,100,000	1,960,550	37,450			**6,098,000**
Austria	624,110	3,293,175	47,069			**3,964,354**
Barbados		82,104				**82,104**
Belgium	46,875	207,120	20,513			**274,508**
Brazil	802,830	3,490,377				**4,293,206**
Bulgaria		30,336				**30,336**
Canada	725,277	91,131	5,597	157,533	1,327	**980,865**
Chile	1,470	17,730				**19,200**
China		10,243,297	114,756,703			**125,000,000**
Cyprus		801,637	1,883			**803,520**
Czech Republic	14,621	118,646	23,030			**156,298**
Denmark	20,515	407,866	5,184	3,264	18,000	**454,829**
Estonia		1,891				**1,891**
Finland	11,779	23,318	1,142			**36,240**
France	100,320	1,734,240	31,680			**1,866,240**
Germany	720,000	9,296,731	1,021,423		33,600	**11,071,754**
Greece		3,870,000				**3,870,000**
Hungary	2,688	47,846	4,858			**55,392**
India		2,508,948	22,247		16,320	**2,547,515**
Ireland		57,009	19,001			**76,010**
Israel	26,700	3,772,878		422		**3,800,000**
Italy	25,219	1,200,000	249,600			**1,474,819**
Japan		5,772,026	101,618		441,856	**6,315,500**
Jordan		642,477	250,588			**893,065**
Korea		1,427,834				**1,427,834**
Latvia		6,864				**6,864**
Lithuania		4,118				**4,118**
Luxembourg		20,832	768			**21,600**
Macedonia		22,018	724			**22,742**
Malta		33,946				**33,946**
Mexico	496,591	537,430				**1,034,021**
Namibia		6,365	377			**6,742**
Netherlands	360,815	342,926				**703,741**
New Zealand	6,544	118,361	9,644			**134,550**
Norway	1,709	11,760	346		1,152	**14,966**
Poland	1,248	276,186	73,474	2,880	2,400	**356,188**
Portugal	1,340	340,700	12,131			**354,172**
Romania		74,496				**74,496**
Slovak Republic		96,292	10,955			**107,246**
Slovenia		118,656	4,042			**122,698**
South Africa	699,678	258,314	17,368			**975,360**
Spain	86,400	1,459,200	96,000			**1,641,600**
Sweden	105,000	235,000	41,000			**381,000**
Switzerland**	211,800	509,980	29,930	845,000		**1,596,710**
Taiwan	1,860	1,648,836	46,991			**1,697,686**
Thailand		76,742				**76,742**
Tunisia		279,862	6,218			**286,080**
Turkey		10,636,800				**10,636,800**
United Kingdom		312,163	58,320			**370,483**
United States	17,727,143	2,110,364	614,546	93	162,145	**20,614,290**
Uruguay		4,861				**4,861**
Zimbabwe		17,292	24			**17,316**
TOTAL	**26,922,531**	**70,716,816**	**117,622,779**	**1,009,192**	**676,799**	**216,948,117**

* If no data is given: no reliable database for this collector type is available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 2: Total installed collector area in operation at the end of 2008 [m²]

The 2008 distribution of the total installed capacity by the different types of solar collectors worldwide in operation is shown in **Figure 4**.

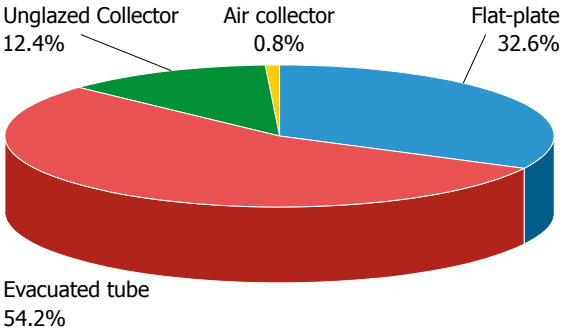


Figure 4: Distribution of the worldwide capacity in operation by collector type in 2008

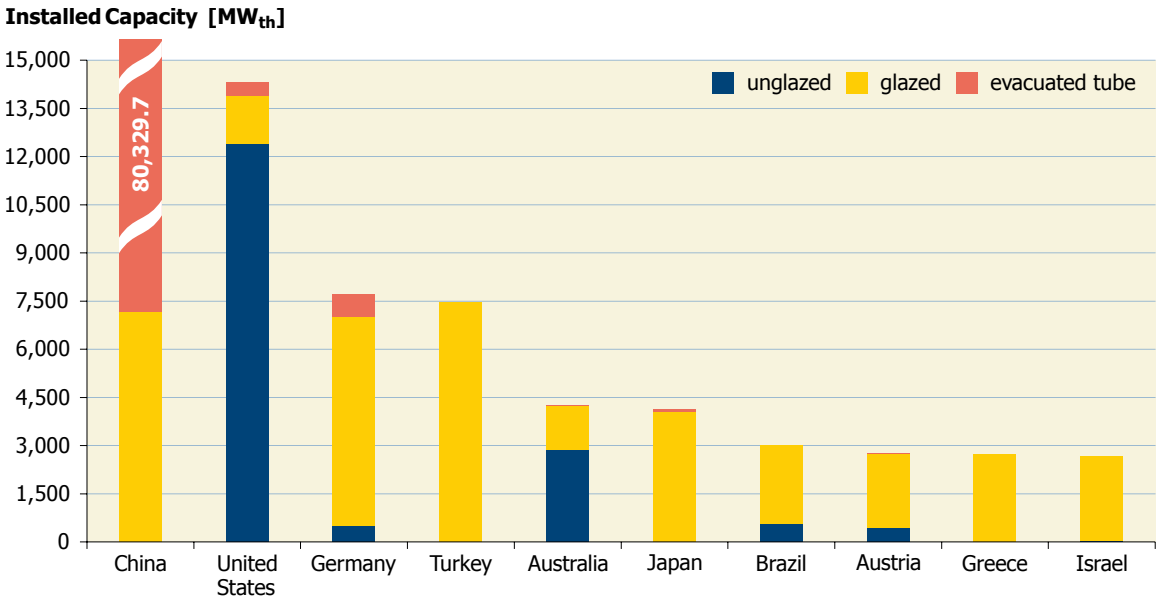


Figure 5: Total capacity of water collectors in operation in the 10 leading countries at the end of 2008

Figure 5 clearly shows how the different types of collectors are applied in the different countries. China, as world leader in total capacity, is focusing very much on evacuated tube collectors, whereas the United States are holding second position due to its high installation of unglazed water collectors. Only in Australia is the unglazed collector as important as in the United States. The rest of the "top 10 countries" are clearly focusing on the flat-plate collector.

In comparison to 2007, the top two positions remained the same. However Germany jumped ahead of Turkey in 2008 in terms of total installed capacity because of its significant market growth of about 116%.

Israel lost its 7th position in 2007 and dropped behind Brazil, Austria and Greece in 2008. This was due to the fact that a considerable number older installations were replaced and this was taken into account in this year's report.

3.2 Total capacity of glazed flat-plate and evacuated tube collectors at the end of 2008

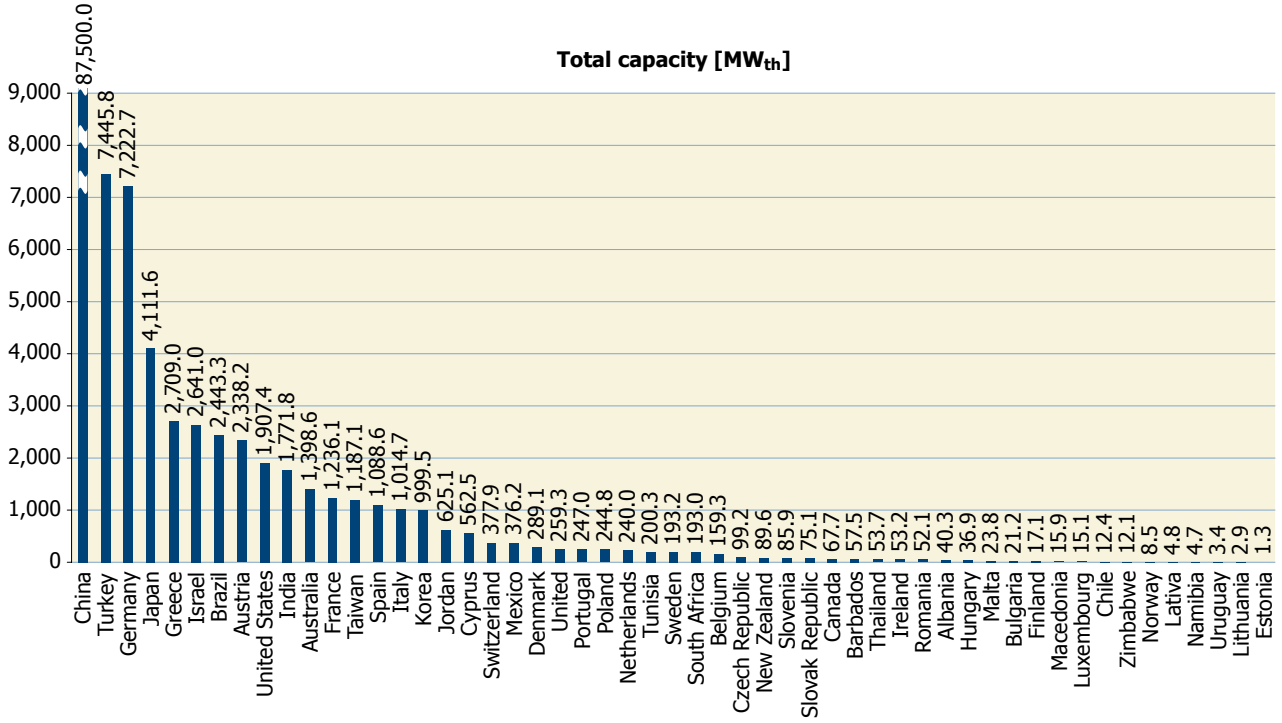


Figure 6: Total capacity of glazed flat-plate and evacuated tube collectors in operation at the end of 2008

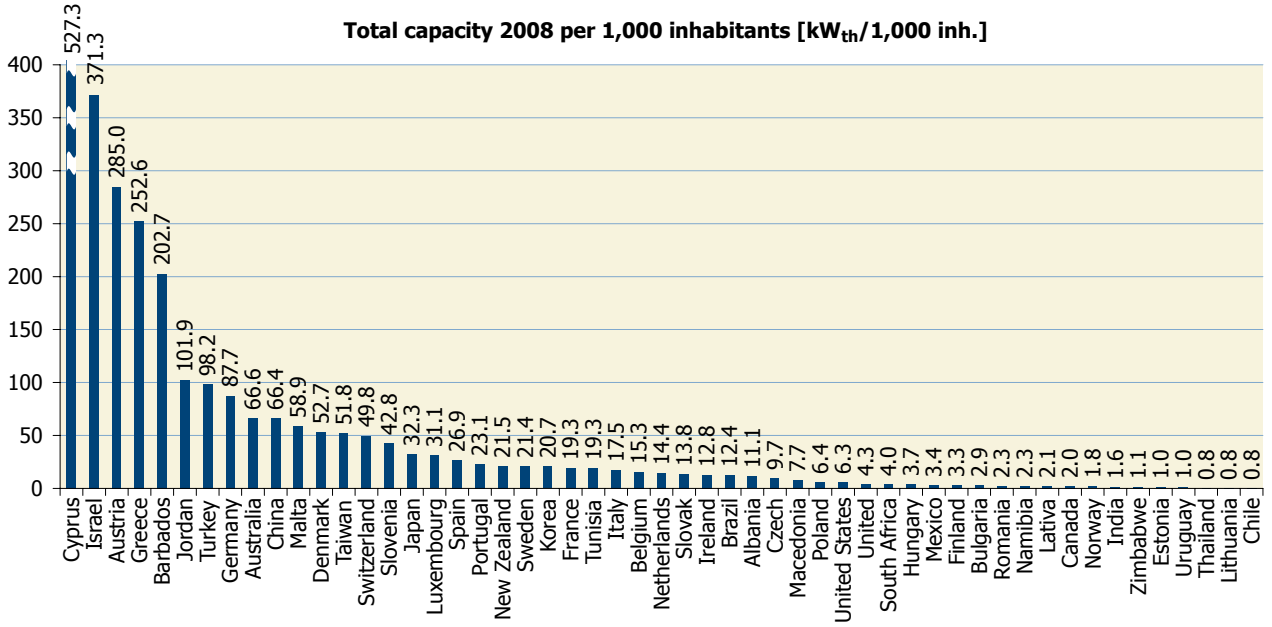
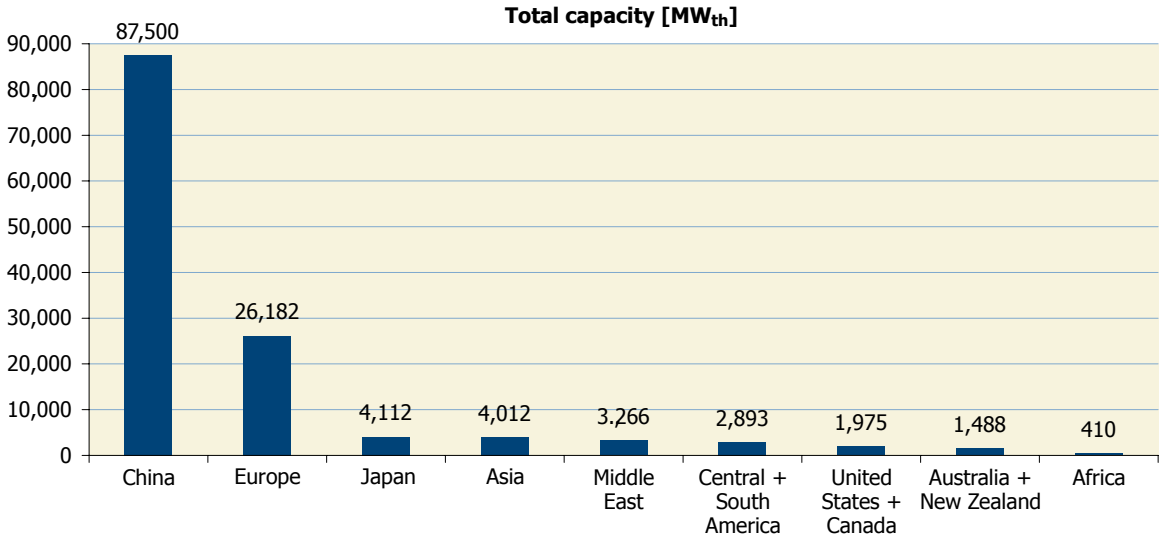


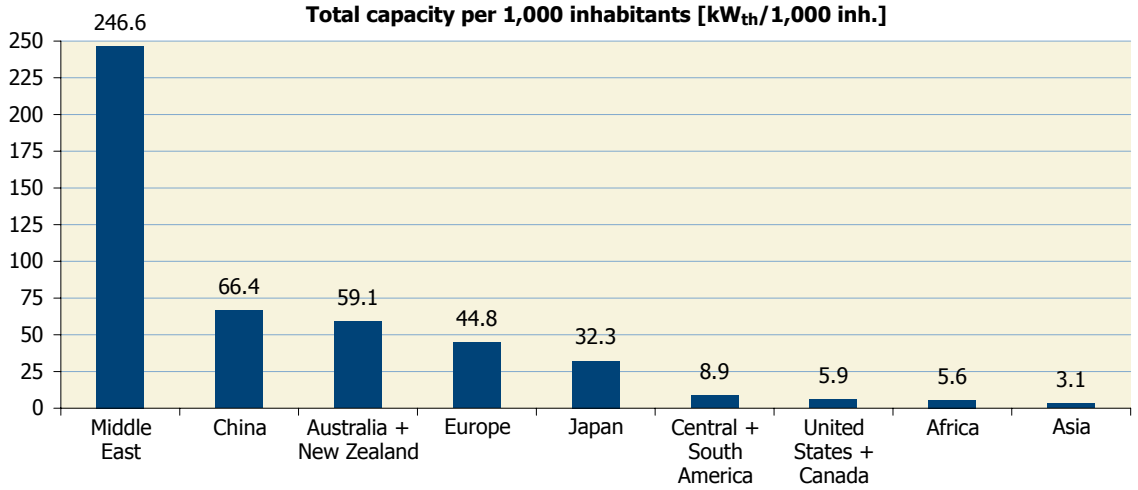
Figure 7: Total capacity of glazed flat-plate and evacuated tube collectors in operation at the end of 2008 in kW_{th} per 1,000 inhabitants

3.3 Total capacity of glazed flat-plate and evacuated tube collectors in operation at the end of 2008 by economic region



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

Figure 8: Total capacity of glazed flat-plate and evacuated tube collectors in operation by economic region at the end of 2008



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

Figure 9: Total capacity of glazed flat-plate and evacuated tube collectors in operation by economic region at the end of 2008 in kW_{th} per 1,000 inhabitants

3.4 Total capacity of unglazed water collectors in operation at the end of 2008

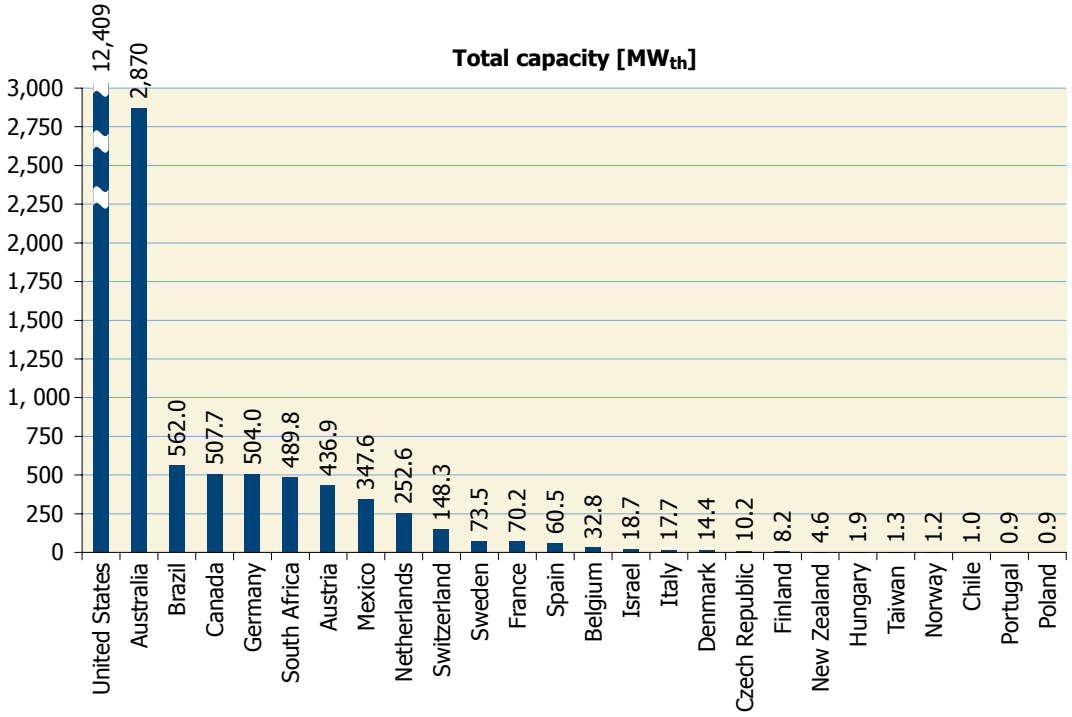


Figure 10: Total capacity of unglazed water collectors in operation at the end of 2008

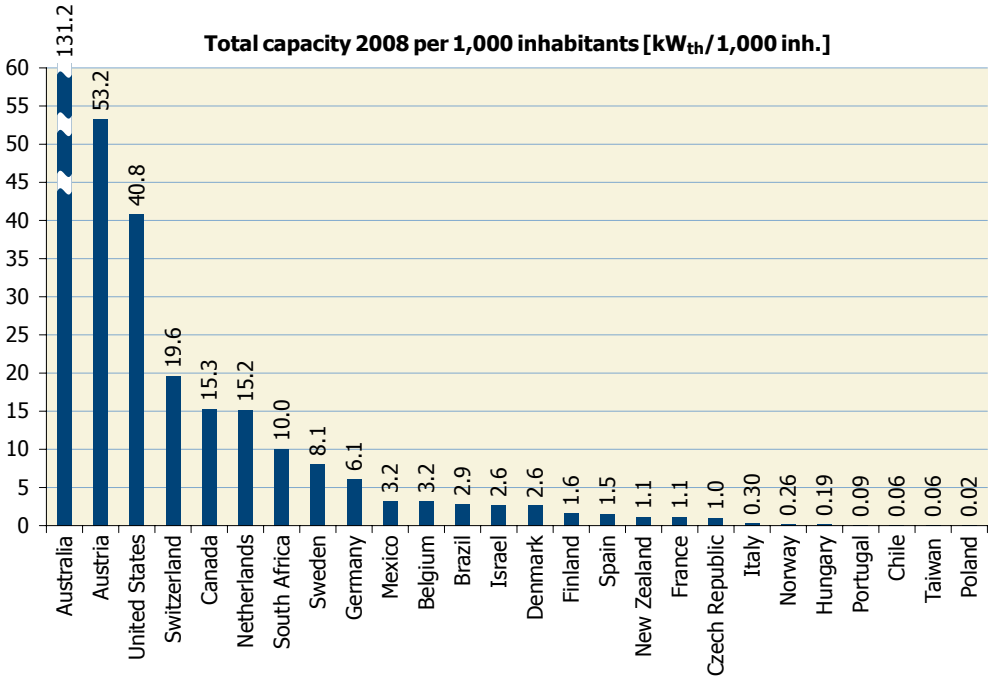
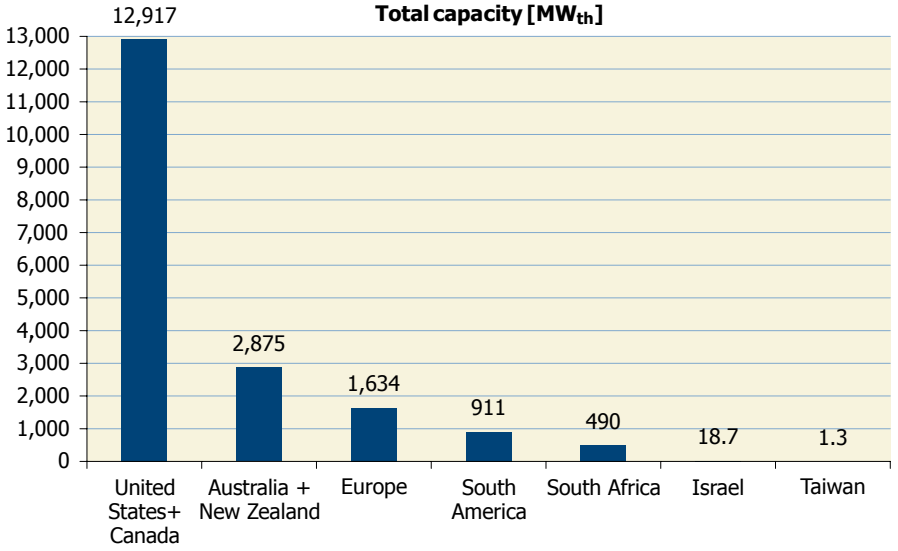


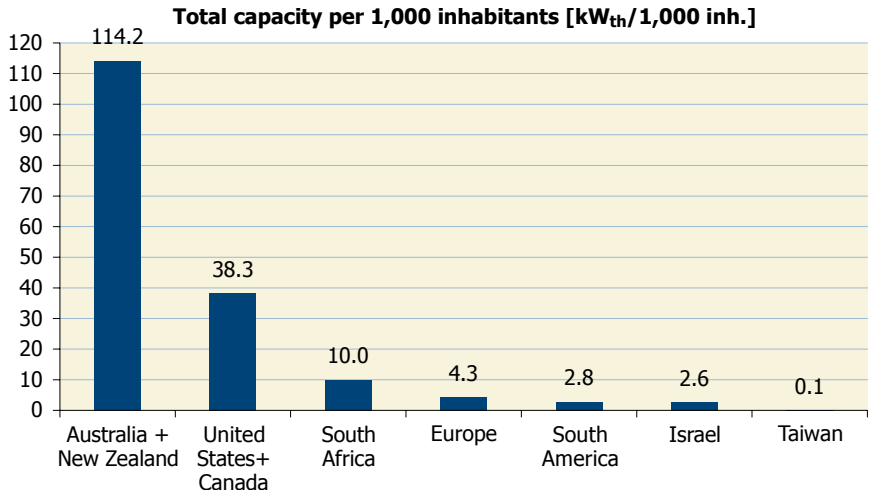
Figure 11: Total capacity of unglazed water collectors in operation at end of 2008 in kW_{th} per 1,000 inhabitants

3.5 Total capacity of unglazed water collectors in operation by economic region at the end of 2008



South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 12: Total capacity of unglazed collectors in operation by economic region at the end of 2008



South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 13: Total capacity of unglazed collectors in operation by economic region at the end of 2008 in kW_{th} per 1,000 inhabitants

4 Market development

4.1 Newly installed capacity in 2008

In the year 2008, a capacity of 29.1 GW_{th} corresponding to 41.5 million square meters of solar collectors were installed worldwide. Flat-plate and evacuated tube collectors accounted for 27.5 GW_{th}, representing 94.6% of the overall market.

The main markets for flat-plate and evacuated tube collectors worldwide were in China (21.7 GW_{th}) and Europe (4.0 GW_{th}), which together account for 93.5%. The rest of the market is shared between Central and South America represented by Barbados, Brazil, Chile, Mexico and Uruguay (0.48 GW_{th}), the Asian countries of India, South Korea, Taiwan, Thailand (0.47 GW_{th}), the Middle East represented by Israel and Jordan (0.23 GW_{th}), Australia and New Zealand (0.22 GW_{th}), the United States and Canada (0.17 GW_{th}), Japan (0.15 GW_{th}) and Africa represented by Namibia, South Africa, Tunisia and Zimbabwe (0.09 GW_{th}).

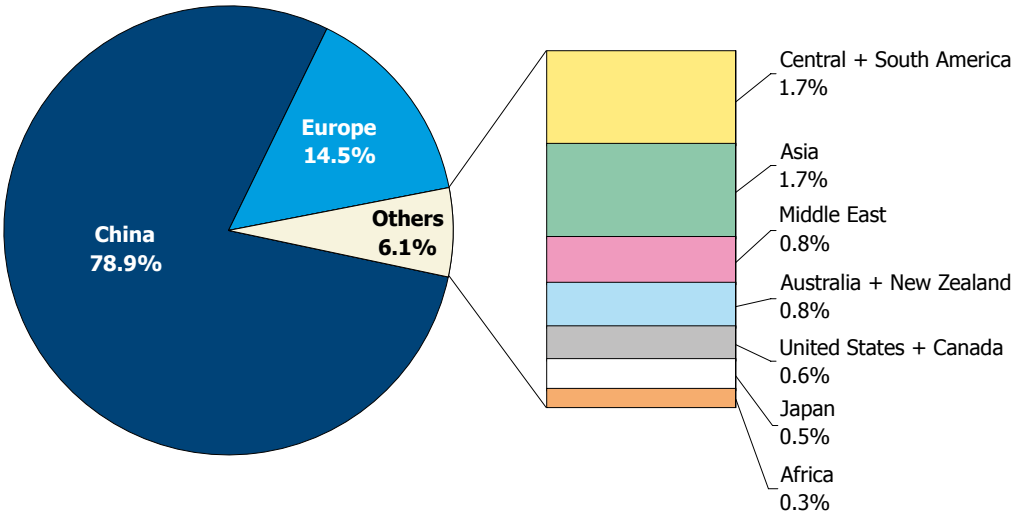


Figure 14: Share of the newly installed capacity of glazed water collectors by economic region in 2008

It is remarkable that after a stagnating market of flat plate collectors in the year 2007 (a market growth 3.3% compared to 2006) that the market recovered 2008 with a growth rate of 42.7% compared to 2007. The market of evacuated tube collectors experienced once again a high growth rate, 35.4% in 2008, mainly due to the relentless growing market in China.

It should be mentioned that the Chinese market, as the absolute leader in vacuum tube collector production, is influencing other markets worldwide. Besides China and Jordan, in all the other recorded countries the flat plate collector remains the dominant collector type. Nevertheless, it is a remarkable trend that the evacuated tube collectors gained considerable market shares in Germany, Italy, Poland, the United States, the United Kingdom and Spain (**Figure 15**). In South Africa and Sweden evacuated tube collectors reached nearly similar market shares as the flat plate collector.

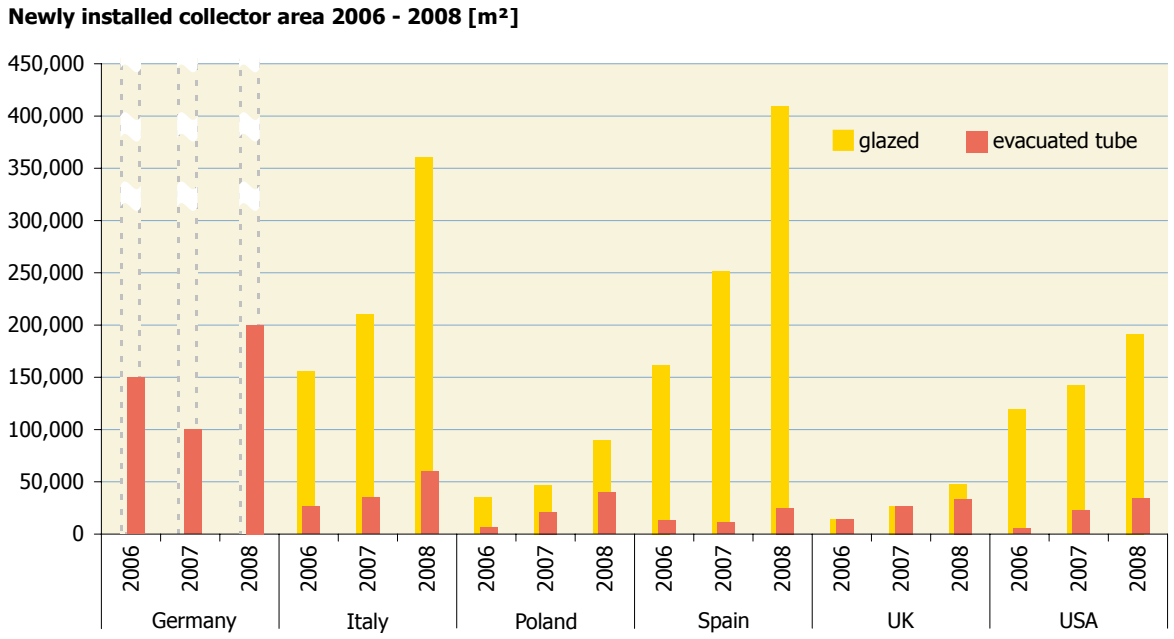


Figure 15: Annual flat plate and evacuated tube collector installations 2006–2008

The main markets for unglazed water collectors are found in the United States (0.8 GW_{th}) and Australia (0.4 GW_{th}) Notable markets also can be found in Brazil (0.08 GW_{th}) as well as in Austria, Canada, Mexico, South Africa, Spain, Sweden and Switzerland with values between 0.07 and 0.01 GW_{th} of new installed unglazed water collectors in 2008.

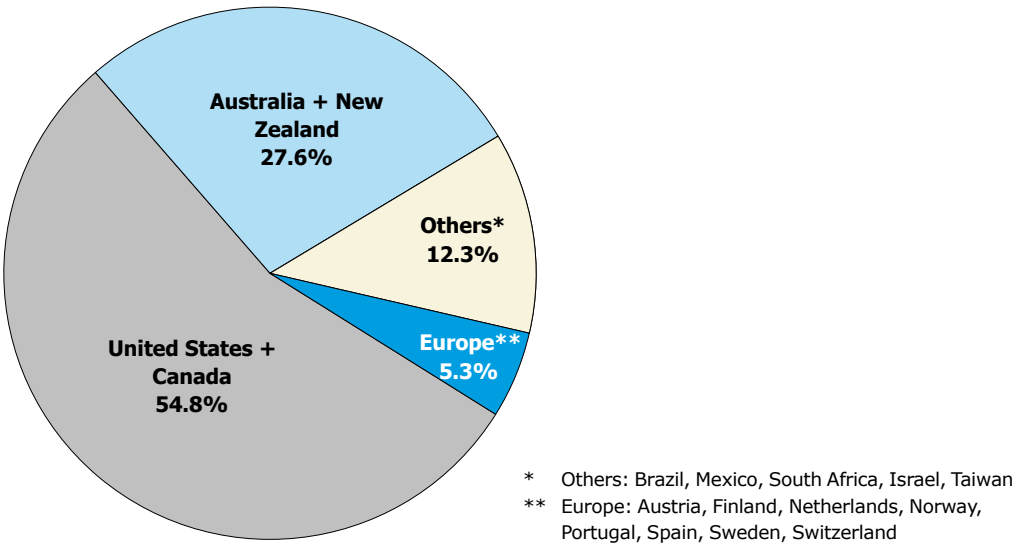


Figure 16: Share of the newly installed capacity of unglazed water collectors by economic region in 2008

After a decrease of unglazed water collector installations in 2007 (- 5.5%), the market grew 5.4% in 2008.

The following tables show the annually installed capacity (**Table 3**) and the annually installed collector area (**Table 4**) in the recorded countries in 2008.

In the Appendix the tables containing data of the newly installed collector area for the years 2006 and 2007 (**Table 15** and **Table 16**) can be found as well as the total installed collector area in 2007 (**Table 17**).

Country	Water Collectors*			Air Collectors*		TOTAL [MW_{th}/a]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		6.8	0.1			**6.9**
Australia	420.0	193.9	9.8			**623.7**
Austria	10.7	240.5	2.9			**254.0**
Barbados		1.9				**1.9**
Belgium		57.4	6.3			**63.7**
Brazil	81.3	388.5				**469.8**
Bulgaria		2.8				**2.8**
Canada	62.7	9.2	0.8	23.9	0.8	**97.4**
Chile		6.3				**6.3**
China		1,085.0	20,615.0			**21,700.0**
Cyprus		28.2	0.7			**28.9**
Czech Republic		18.6	6.0			**24.5**
Denmark		21.7	1.4			**23.1**
Estonia		0.4				**0.4**
Finland	0.2	2.7	0.5			**3.4**
France		273.0				**273.0**
Germany		1,330.0	140.0		4.8	**1,474.8**
Greece		208.6				**208.6**
Hungary		6.0	1.8			**7.7**
India		324.4	16.2			**340.7**
Ireland		22.2	8.3			**30.5**
Israel	1.8	194.6				**196.4**
Italy		252.0	42.0			**294.0**
Japan		143.9	1.4		9.4	**154.7**
Jordan		14.0	21.0			**35.1**
Korea		36.1				**36.1**
Latvia		1.3				**1.3**
Lithuania		0.6				**0.6**
Luxembourg		2.0	0.6			**2.5**
Macedonia		2.7	0.4			**3.1**
Malta		4.2				**4.2**
Mexico	34.8	81.2				**115.9**
Namibia		2.8	0.1			**2.9**
Netherlands	19.8	16.4				**36.1**
New Zealand	0.4	14.3				**14.7**
Norway	0.1	0.7	0.1			**1.0**
Poland		62.9	27.9			**90.7**
Portugal	0.6	55.2	5.0			**60.8**
Romania		5.6				**5.6**
Slovak Republic		8.4	1.1			**9.5**
Slovenia		9.8	1.8			**11.6**
South Africa	70.2	15.0	12.7			**97.8**
Spain	22.4	286.3	17.5			**326.2**
Sweden	20.1	10.2	8.6			**38.8**
Switzerland**	6.6	72.8	6.2	4.9		**90.4**
Taiwan	0.2	74.0	8.2			**82.4**
Thailand		7.0				**7.0**
Tunisia		52.5	3.5			**56.0**
Turkey		651.0				**651.0**
United Kingdom		33.1	23.6			**56.7**
United States	773.9	134.1	23.7		1.8	**933.5**
Uruguay		2.9				**2.9**
Zimbabwe		0.2	0.02			**0.3**
TOTAL	**1,525.5**	**6,475.8**	**21,014.9**	**28.8**	**16.9**	**29,061.77**

* If no data is given: no reliable database for this collector type is available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 3: Newly installed capacity in 2008 [MW_{th}/a]

Country	Water Collectors*			Air Collectors*		TOTAL [m²]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		9,740	104			9,844
Australia	600,000	277,000	14,000			891,000
Austria	15,220	343,617	4,086			362,923
rBarbados		2,731				2,731
Belgium		82,000	9,000			91,000
Brazil	116,110	555,046				671,156
Bulgaria		4,000				4,000
Canada	89,577	13,173	1,083	34,135	1,191	139,159
Chile		9,000				9,000
China		1,550,000	29,450,000			31,000,000
Cyprus		40,290	1,000			41,290
Czech Republic		26,500	8,500			35,000
Denmark		31,000	2,000			33,000
Estonia		500				500
Finland	270	3,905	650			4,825
France		390,000				390,000
Germany		1,900,000	200,000		6,900	2,106,900
Greece		298,000				298,000
Hungary		8,500	2,500			11,000
India		463,487	23,174			486,662
0Ireland		31,727	11,883			43,610
Israel	2,500	278,000				280,500
Italy		360,000	60,000			420,000
Japan		205,622	1,946		13,386	220,954
Jordan		20,041	30,062			50,103
Korea		51,552				51,552
Latvia		1,800				1,800
Lithuania		840				840
Luxembourg		2,800	800			3,600
Macedonia		3,866	554			4,420
Malta		6,000				6,000
Mexico	49,690	115,943				165,633
Namibia		3,952	203			4,154
Netherlands	28,216	23,414				51,630
New Zealand	600	20,379				20,979
Norway	180	1,030	210			1,420
Poland		89,820	39,812			129,632
Portugal	802	78,858	7,160			86,820
Romania		8,000				8,000
Slovak Republic		12,000	1,500			13,500
Slovenia		14,000	2,500			16,500
South Africa	100,222	21,397	18,092			139,710
Spain	32,000	409,000	25,000			466,000
Sweden	28,648	14,530	12,283			55,461
Switzerland**	9,374	104,040	8,793	7,000		129,207
Taiwan	330	105,683	11,751			117,764
Thailand		9,939				9,939
Tunisia		75,000	5,000			80,000
Turkey		930,000				930,000
United Kingdom		47,250	33,750			81,000
United States	1,105,537	191,564	33,816		2,601	1,333,519
Uruguay		4,213				4,213
Zimbabwe		336	24			360
TOTAL	**2,179,275**	**9,251,085**	**30,021,236**	**41,135**	**24,079**	**41,516,810**

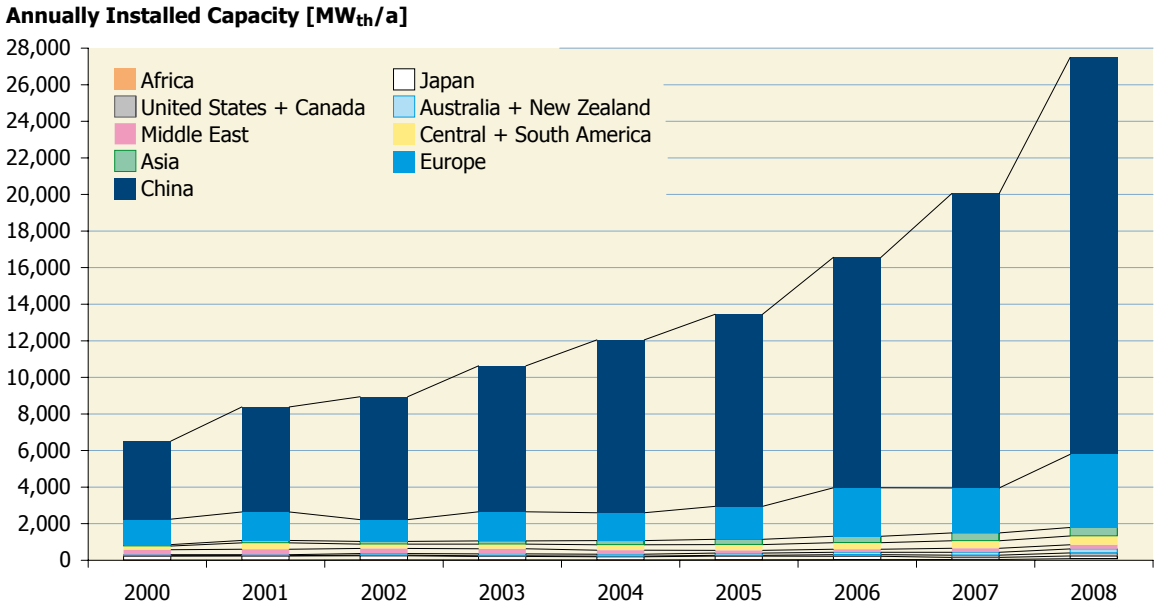
* If no data is given: no reliable database for this collector type is available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 4: Newly Installed collector area in 2008 [m²/a]

4.2 Market development of glazed flat-plate and evacuated tube collectors by economic region

Analyzing the market development of glazed water collectors, from 2000 to 2008, it can be seen that the market of flat-plate and evacuated tube collectors grew significantly during this time period (see **Figure 17**).



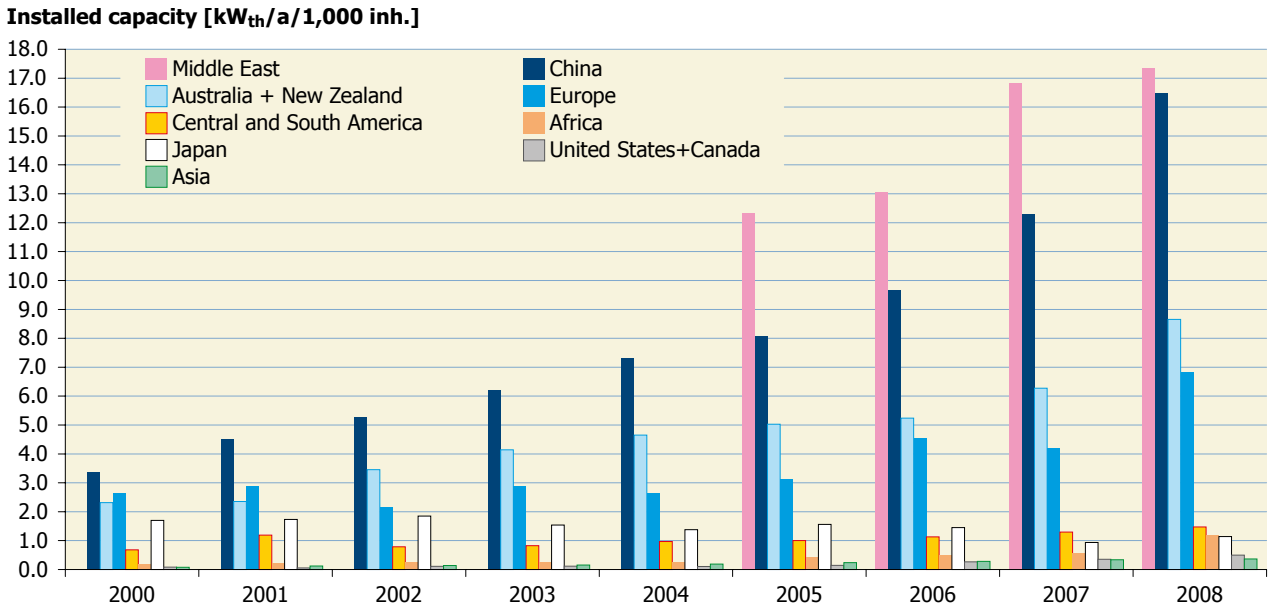
Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

Figure 17: Annual installed capacity of flat-plate and evacuated tube collectors from 2000 to 2008

The annually installed glazed water collector area worldwide in 2008 was more than 4 times higher than in the year 2000, and doubled between 2005 and 2008. The worldwide average annual growth rate between 2000 and 2008 was 20.1%.

Compared to the year 2007, the worldwide market for glazed water collectors grew by 37.1%. Especially high growth rates occurred in Europe (+ 62.5%), the United States and Canada (+ 41.8%), Australia and New Zealand (+ 39.7%) and China (+ 34.8%) are responsible for the above average growth in 2008.

After a market decline in Japan in 2007, the growth rate in 2008 was positive again in 2008 (+ 21.9%).



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

Figure 18: Annually installed capacity of flat-plate and evacuated tube collectors in kW_{th} per 1,000 inhabitants from 2000 to 2008

Besides Israel and Jordan, the Chinese market led in terms of specific collector area installed (capacity/inhabitant), although China loses absolute dominance due to its large population.

4.3 Market development of unglazed water collectors by economic region

In the United States and Australia, unglazed collectors play an important role. In other large markets, such as China, Turkey, India and Japan, unglazed collectors almost do not exist. In Europe, the annual installations of unglazed collectors remain at a fairly constant level of around 80 MW_{th} per year and around 45 MW_{th} per year in the reported African countries.

The worldwide market of unglazed collectors for swimming pool heating recorded an increase in 2000 and remained steady between 2001 and 2003. After a slight increase from 2004 to 2006 the installed capacity rate decreased again in 2007, mainly due to the major market decline in the United States and Canada (see **Figure 19**).

In 2008, a significant growth was recorded Canada and South Africa. All other markets remained quite stable.

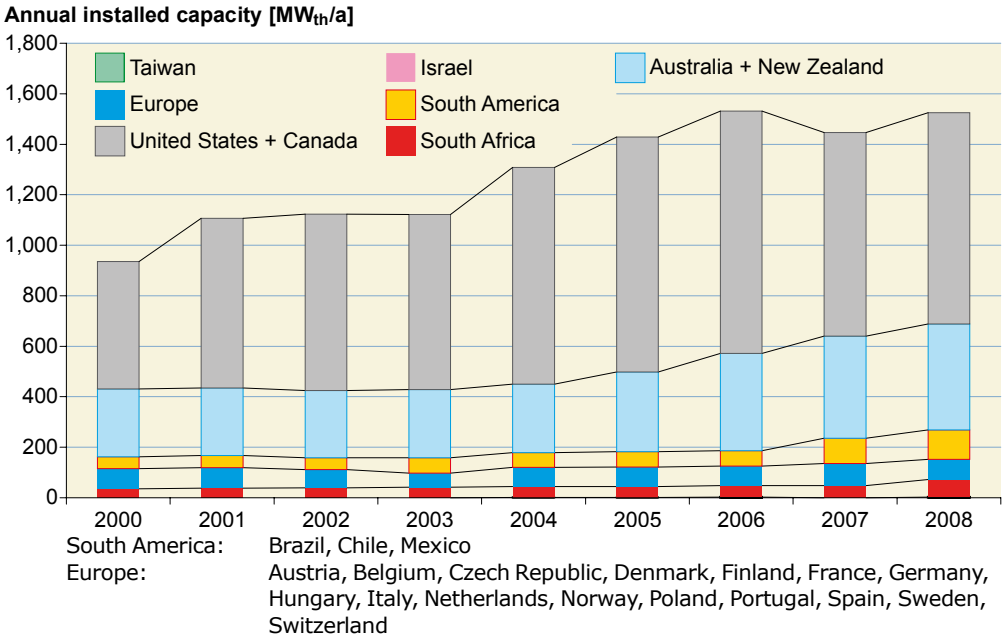


Figure 19: Annual installed capacity of unglazed water collectors from 2000 to 2008

5 Contribution to the energy supply and CO_2 reduction

In this section, the contribution of installed water collectors to the energy supply and CO_2 reduction is shown. The data for air collector applications was insufficient; therefore, the contribution of air collectors to the energy supply and CO_2 reduction was not calculated.

The basis for these calculations is the total collector area in operation in each country. As shown in **Table 1**, flat-plate and evacuated tube collector capacity was 131.8 GW_{th} and unglazed plastic collector capacity was 18.9 GW_{th} for installed collectors at the end of the year 2008 in the recorded countries.

The annual collector yield was 109,713 GWh (394,968 TJ). This corresponds to an oil equivalent of 12.4 million tons and an annual avoidance of 39.4 million tons of CO_2.

The methodology for the calculation of the annual collector yield is described in detail in the Annex (see **chapter 7.1**).

Table 5 summarizes the calculated annual collector yields and the corresponding oil equivalents and CO_2 reductions of all solar thermal systems (systems for hot water, space heating and swimming pool heating) installed by the end of 2008.

Table 6 and **Table 7** show the results for glazed water collectors and unglazed swimming pool collectors respectively.

Country	Total glazed (flate plate and evacuated tube collectors) and unglazed Water Collectors						
	Total collector area [m²]	**Total capacity** [MW_{th}]	**Calculated number of systems**	**Collector yield** [GWh/a]	**Collector yield** [TJ/a]	**Energy savings: Oil equivalent** [t/a]	**CO_2 reduction** [t/a]
Albania	57,619	40.3	6,845	40.5	146.0	5,074	**16,089**
Australia	6,098,000	4,268.6	490,377	2,992.1	10,771.5	351,958	**1,113,857**
Austria	3,964,354	2,775.0	389,599	1,311.7	4,722.0	154,720	**490,722**
Barbados	82,104	57.5	20,526	61.2	220.4	6,252	**19,804**
Belgium	274,508	192.2	57,143	93.2	335.4	11,247	**35,621**
Brazil	4,293,206	3,005.2	764,218	2,704.4	9,735.7	298,904	**946,384**
Bulgaria	30,336	21.2	5,579	13.8	49.7	1,761	**5,568**
Canada	980,865	575.4	19,038	310.1	1,116.5	31,667	**99,893**
Chile	19,200	13.4	4,440	12.2	44.0	1,620	**5,131**
China	125,000,000	87,500.0	28,493,750	62,893.8	226,417.6	7,145,526	**22,616,779**
Cyprus	803,520	562.5	167,614	624.4	2,248.0	69,169	**218,698**
Czech Republic	156,298	109.4	23,478	51.9	186.8	6,040	**19,130**
Denmark	454,829	303.5	90,326	167.1	601.6	19,929	**63,107**
Estonia	1,891	1.3	473	0.7	2.5	81	**256**
Finland	36,240	25.4	5,893	12.9	46.4	1,464	**4,638**
France	1,866,240	1,306.4	352,803	748.3	2,693.9	94,372	**298,875**
Germany	11,071,754	7,726.7	1,397,411	3,834.6	13,804.5	470,477	**1,489,896**
Greece	3,870,000	2,709.0	911,946	2,536.4	9,131.1	272,368	**862,879**
Hungary	55,392	38.8	8,720	22.3	80.3	2,858	**9,051**
India	2,547,515	1,771.8	458,146	1,941.1	6,988.0	219,839	**697,657**
729 Ireland	76,010	53.2	17,416	27.3	98.3	3,051	**9,662**
Israel	3,800,000	2,659.7	925,998	3,402.6	12,249.3	355,354	**1,125,664**
Italy	1,474,819	1,032.4	362,526	780.2	2,808.7	105,533	**334,291**
Japan	6,315,500	4,111.6	1,421,813	3,164.9	11,393.7	361,516	**1,144,991**
Jordan	893,065	625.1	174,898	723.5	2,604.6	78,686	**249,351**
Korea	1,427,834	999.5	205,894	749.8	2,699.4	89,386	**284,463**
Lativa	6,864	4.8	1,716	2.7	9.8	313	**992**
Lithuania	4,118	2.9	1,030	1.6	5.7	195	**618**
Luxembourg	21,600	15.1	5,400	8.3	29.8	1,002	**3,175**
Macedonia	22,742	15.9	4,901	11.7	42.0	1,541	**4,884**
Malta	33,946	23.8	8,486	24.1	86.7	3,380	**10,706**
Mexico	1,034,021	723.8	47,842	480.9	1,731.4	61,971	**196,976**
Namibia	6,742	4.7	851	5.3	19.1	658	**2,082**
Netherlands	703,741	492.6	100,361	205.8	740.9	23,030	**72,961**
New Zealand	134,550	94.2	30,562	71.5	257.5	9,038	**28,635**
Norway	14,966	9.7	1,998	5.1	18.3	590	**1,869**
Poland	356,188	245.6	41,441	128.8	463.7	15,924	**50,443**
Portugal	354,172	247.9	84,157	225.5	811.9	31,412	**99,549**
Romania	74,496	52.1	18,624	36.8	132.6	4,834	**15,312**
Slovak Republic	107,246	75.1	17,874	44.5	160.2	5,742	**18,061**
trightSlovenia	122,698	85.9	18,556	44.6	160.6	5,666	**17,837**
South Africa	975,360	682.8	72,419	584.5	2,104.3	59,754	**189,154**
Spain	1,641,600	1,149.1	240,970	994.7	3,581.0	129,021	**408,835**
Sweden	381,000	266.7	22,275	118.3	426.0	13,406	**42,427**
Switzerland	1,596,710	526.2	73,461	250.9	903.2	29,075	**92,077**
Taiwan	1,697,686	1,188.4	417,499	918.4	3,306.2	101,780	**322,393**
Thailand	76,742	53.7	19,185	52.0	187.4	5,378	**17,037**
Tunisia	286,080	200.3	69,546	227.0	817.2	24,135	**76,445**
Turkey	10,636,800	7,445.8	2,487,948	7,880.4	28,369.5	879,984	**2,786,683**
United Kingdom	370,483	259.3	92,621	128.8	463.8	16,439	**52,077**
United States	20,614,290	14,316.4	542,787	8,024.9	28,889.6	842,893	**2,670,575**
Uruguay	4,861	3.4	1,215	2.8	9.9	377	**1,195**
Zimbabwe	17,316	12.1	4,329	12.1	43.7	1,777	**5,628**
TOTAL	**216,948,117**	**150,683.5**	**41,204,925**	**109,713.4**	**394,968.2**	**12,428,168**	**39,351,084**

Table 5: Calculated annual collector yield and corresponding oil equivalent as well as CO_2 reduction of all solar thermal systems (systems for hot water, space heating and swimming pool heating) installed by the end of 2008.

Country	Glazed (flate plate and evacuated tube collectors) Water Collectors						
	Total collector area [m²]	**Total capacity** [MW_{th}]	**Calculated number of systems**	**Collector yield** [GWh/a]	**Collector yield** [TJ/a]	**Energy savings: Oil equivalent** [t/a]	**CO_2 reduction** [t/a]
Albania	57,619	40.3	6,845	40.5	146.0	5,074	**16,089**
Australia	1,998,000	1,398.6	470,697	1,258.6	4,530.9	181,687	**575,516**
Austria	3,340,244	2,338.2	386,479	1,140.0	4,103.9	137,944	**437,401**
Barbados	82,104	57.5	20,526	61.2	220.4	6,252	**19,804**
Belgium	227,633	159.3	56,908	81.5	293.5	10,106	**32,012**
Brazil	3,490,377	2,443.3	760,204	2,443.5	8,796.5	273,278	**865,368**
Bulgaria	30,336	21.2	5,579	13.8	49.7	1,761	**5,568**
Canada	96,728	67.7	15,412	47.4	170.5	5,774	**18,283**
Chile	17,730	12.4	4,433	11.4	41.1	1,540	**4,877**
China	125,000,000	87,500.0	28,493,750	62,893.8	226,417.6	7,145,526	**22,616,779**
Cyprus	803,520	562.5	167,614	624.4	2,248.0	69,169	**218,698**
Czech Republic	141,677	99.2	23,405	47.7	171.7	5,629	**17,827**
Denmark	413,050	289.1	90,224	161.2	580.2	19,343	**61,264**
Estonia	1,891	1.3	473	0.7	2.5	81	**256**
Finland	24,461	17.1	5,834	9.3	33.5	1,113	**3,524**
France	1,765,920	1,236.1	352,301	716.2	2,578.4	91,212	**288,910**
Germany	10,318,154	7,222.7	1,393,811	3,614.2	13,010.9	448,704	**1,421,438**
Greece	3,870,000	2,709.0	911,946	2,536.4	9,131.1	272,368	**862,879**
Hungary	52,704	36.9	8,707	21.5	77.2	2,773	**8,784**
India	2,531,195	1,771.8	458,146	1,941.1	6,988.0	219,839	**697,657**
Ireland	76,010	53.2	17,416	27.3	98.3	3,051	**9,662**
Israel	3,772,878	2,641.0	925,864	3,388.4	12,198.4	353,964	**1,121,269**
Italy	1,449,600	1,014.7	362,400	769.7	2,771.1	104,506	**331,045**
Japan	5,873,644	4,111.6	1,421,813	3,164.9	11,393.7	361,516	**1,144,991**
Jordan	893,065	625.1	174,898	723.5	2,604.6	78,686	**249,351**
Korea	1,427,834	999.5	205,894	749.8	2,699.4	89,386	**284,463**
Lativa	6,864	4.8	1,716	2.7	9.8	313	**992**
Lithuania	4,118	2.9	1,030	1.6	5.7	195	**618**
Luxembourg	21,600	15.1	5,400	8.3	29.8	1,002	**3,175**
Macedonia	22,742	15.9	4,901	11.7	42.0	1,541	**4,884**
Malta	33,946	23.8	8,486	24.1	86.7	3,380	**10,706**
Mexico	537,430	376.2	45,359	336.6	1,211.7	47,789	**152,143**
Namibia	6,742	4.7	851	5.3	19.1	658	**2,082**
Netherlands	342,926	240.0	98,557	110.0	395.9	13,635	**43,197**
New Zealand	128,006	89.6	30,529	68.9	248.0	8,780	**27,817**
Norway	12,106	8.5	1,990	4.6	16.5	540	**1,710**
Poland	349,660	244.8	41,435	128.5	462.4	15,890	**50,335**
Portugal	352,831	247.0	84,150	225.0	810.0	31,360	**99,385**
Romania	74,496	52.1	18,624	36.8	132.6	4,834	**15,312**
Slovak Republic	107,246	75.1	17,874	44.5	160.2	5,742	**18,061**
9 Slovenia	122,698	85.9	18,556	44.6	160.6	5,666	**17,837**
South Africa	275,682	193.0	68,920	252.2	908.0	27,135	**85,954**
Spain	1,555,200	1,088.6	240,538	956.8	3,444.4	125,284	**397,050**
Sweden	276,000	193.2	21,771	89.1	320.7	10,527	**33,347**
Switzerland	539,910	377.9	72,402	194.0	698.6	23,470	**74,420**
Taiwan	1,695,827	1,187.1	417,490	917.8	3,304.3	101,726	**322,222**
Thailand	76,742	53.7	19,185	52.0	187.4	5,378	**17,037**
Tunisia	286,080	200.3	69,546	227.0	817.2	24,135	**76,445**
Turkey	10,636,800	7,445.8	2,487,948	7,880.4	28,369.5	879,984	**2,786,683**
United Kingdom	370,483	259.3	92,621	128.8	463.8	16,439	**52,077**
United States	2,724,910	1,907.4	454,152	1,491.7	5,370.2	202,589	**641,678**
Uruguay	4,861	3.4	1,215	2.8	9.9	377	**1,195**
Zimbabwe	17,316	12.1	4,329	12.1	43.7	1,777	**5,628**
TOTAL	**188,339,594**	**131,837.7**	**41,071,153**	**99,746.1**	**359,085.9**	**11,450,425**	**36,255,707**

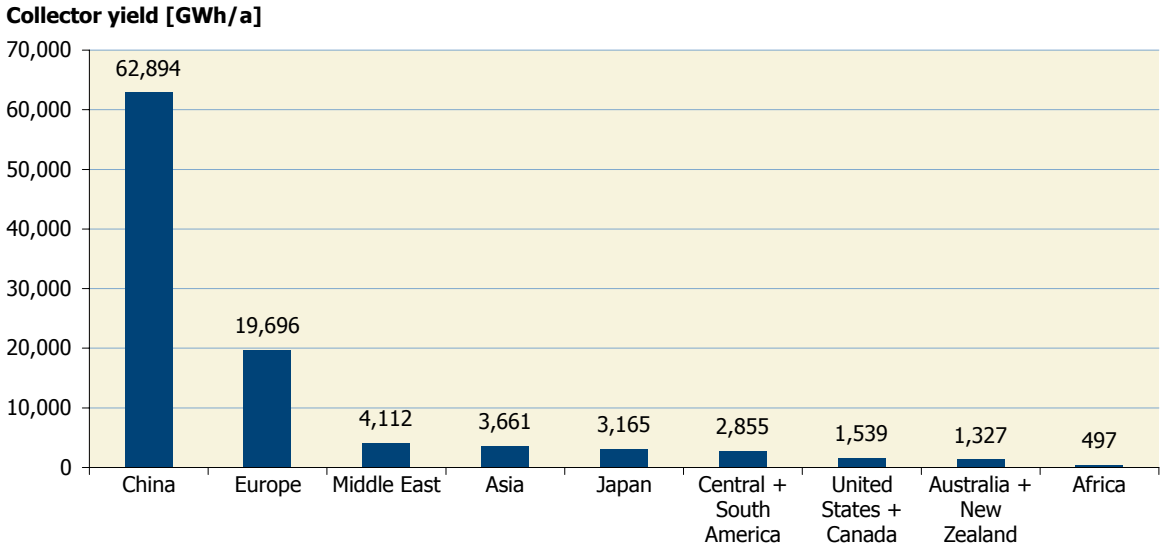
Table 6: Calculated annual collector yield and corresponding oil equivalent as well as CO_2 reduction of solar thermal systems using flat-plate and evacuated tube collectors (for example hot water preparation and space heating, low temperature industrial process heat) installed by the end of 2008

Country	Unglazed Water Collectors (swimming pool collectors)						
	Total collector area [m²]	**Total capacity** [MWth]	**Calculated number of systems**	**Collector yield** [GWh/a]	**Collector yield** [TJ/a]	**Energy savings: Oil equivalent** [tons/a]	**CO_2 reduction** [t/a]
Albania							
Australia	4,100,000	2,870.0	19,680	1,733.5	6,240.6	170,271	**538,341**
Austria	624,110	436.9	3,121	171.7	618.1	16,776	**53,321**
Barbados							
Belgium	46,875	32.8	234	11.6	41.8	1,142	**3,609**
Brazil	802,830	562.0	4,014	260.9	939.2	25,626	**81,016**
Bulgaria							
Canada	725,277	507.7	3,626	262.8	946.0	25,892	**81,610**
Chile	1,470	1.0	7	0.8	2.9	80	**254**
China							
Cyprus							
Czech Republic	14,621	10.2	73	4.2	15.1	411	**1,303**
Denmark	20,515	14.4	103	5.9	21.4	586	**1,843**
Estonia							
Finland	11,779	8.2	59	3.6	12.9	351	**1,113**
France	100,320	70.2	502	32.1	115.5	3,160	**9,965**
Germany	720,000	504.0	3,600	220.4	793.6	21,773	**68,457**
Greece							
parHungary	2,688	1.9	13	0.9	3.1	85	**267**
India							
Ireland							
Israel	26,700	18.7	134	14.2	51.0	1,391	**4,395**
Italy	25,219	17.7	126	10.5	37.6	1,027	**3,246**
Japan							
Jordan							
Korea							
Lativa							
Lithuania							
Luxembourg							
Macedonia							
Malta							
Mexico	496,591	347.6	2,483	144.4	519.7	14,183	**44,833**
Namibia							
Netherlands	360,815	252.6	1,804	95.8	345.0	9,396	**29,763**
New Zealand	6,544	4.6	33	2.6	9.5	258	**818**
Norway	1,709	1.2	9	0.5	1.8	50	**159**
Poland	1,248	0.9	6	0.3	1.2	34	**108**
Portugal	1,340	0.9	7	0.5	1.9	52	**164**
Romania							
Slovak Republic							
Slovenia							
South Africa	699,678	489.8	3,498	332.3	1,196.3	32,619	**103,199**
Spain	86,400	60.5	432	37.9	136.6	3,738	**11,785**
Sweden	105,000	73.5	504	29.2	105.3	2,879	**9,080**
Switzerland	211,800	148.3	1,059	56.9	204.7	5,604	**17,658**
Taiwan	1,860	1.3	9	0.5	2.0	54	**170**
Thailand							
Tunisia							
Turkey							
United Kingdom							
United States	17,727,143	12,409.0	88,636	6,533.2	23,519.4	640,304	**2,028,897**
Uruguay							
Zimbabwe							
TOTAL	**26,922,531**	**18,845.8**	**133,772**	**9,967.3**	**35,882.3**	**977,743**	**3,095,377**

Table 7: Calculated annual collector yield and corresponding oil equivalent as well as CO_2 reduction of solar thermal systems for swimming pool heating with unglazed collectors installed by the end of 2008.

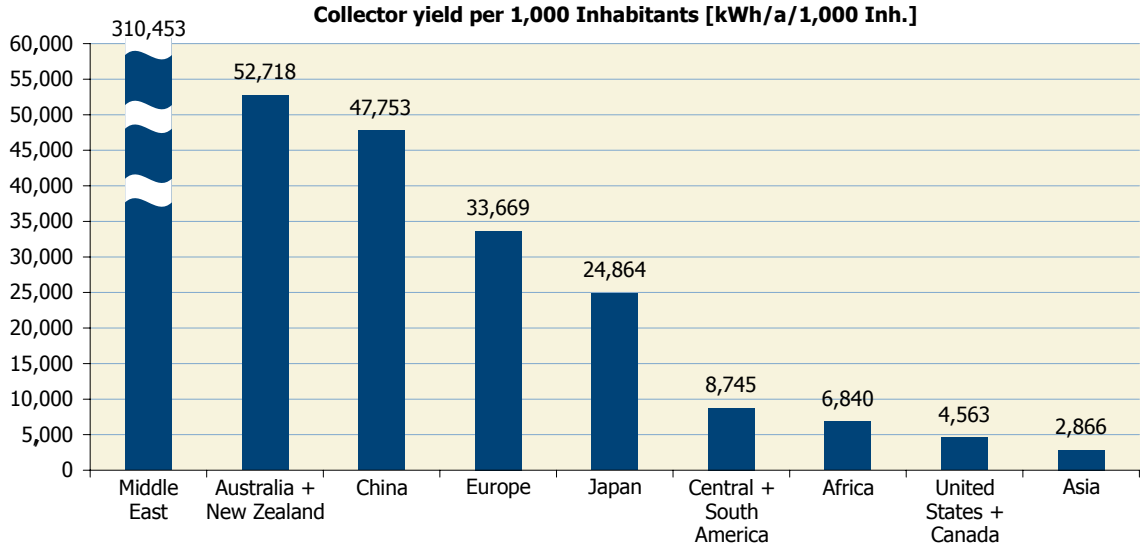
5.1 Collector yield by economic region

5.1.1 Collector yield of glazed flat-plate and evacuated tube collectors by economic region



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

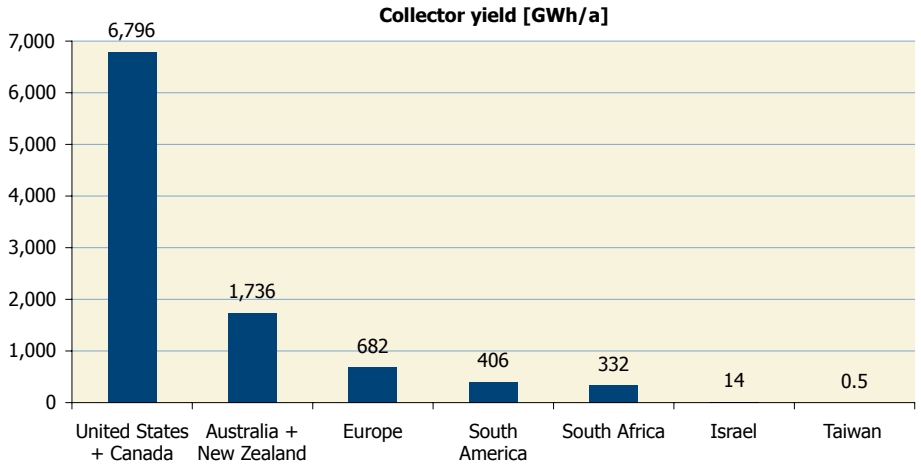
Figure 20: Annual collector yield of glazed flat-plate and evacuated tube collectors in operation by economic region in 2008



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

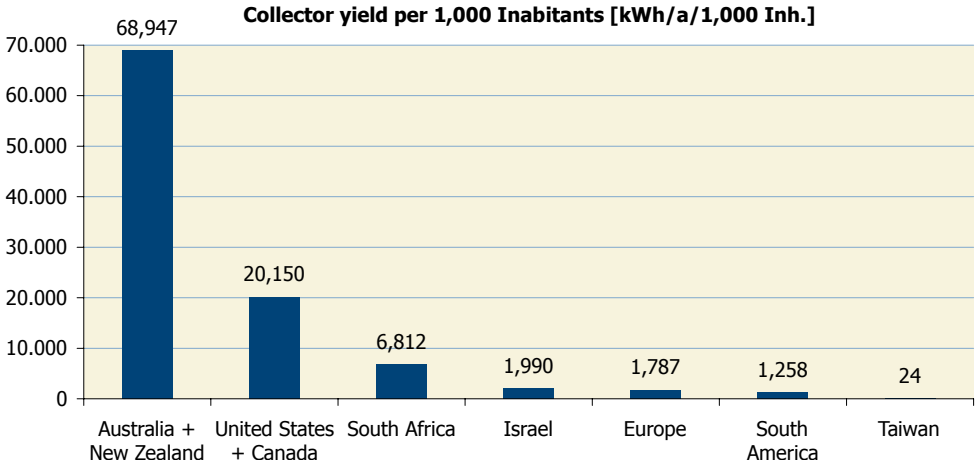
Figure 21: Annual collector yield of glazed flat-plate and evacuated tube collectors in operation by economic region at the end of 2008 in kWh per 1,000 inhabitants

5.1.2 Collector yield of unglazed collectors by economic region



South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 22: Annual collector yield of unglazed collectors in operation by economic region at the end of 2008

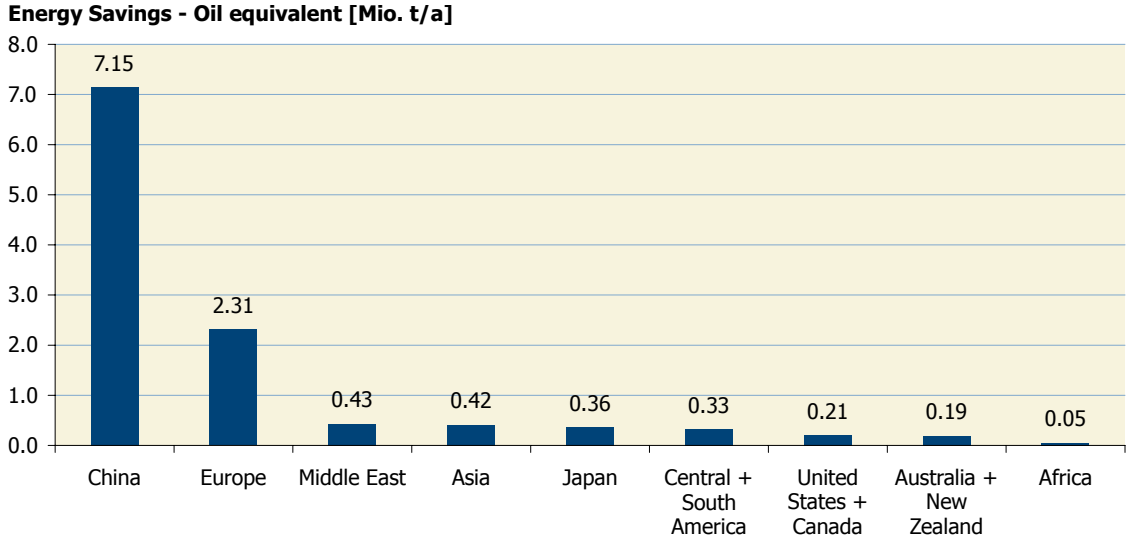


South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 23: Annual collector yield of unglazed collectors in operation by economic region at the end of 2008 in kWh per 1,000 inhabitants

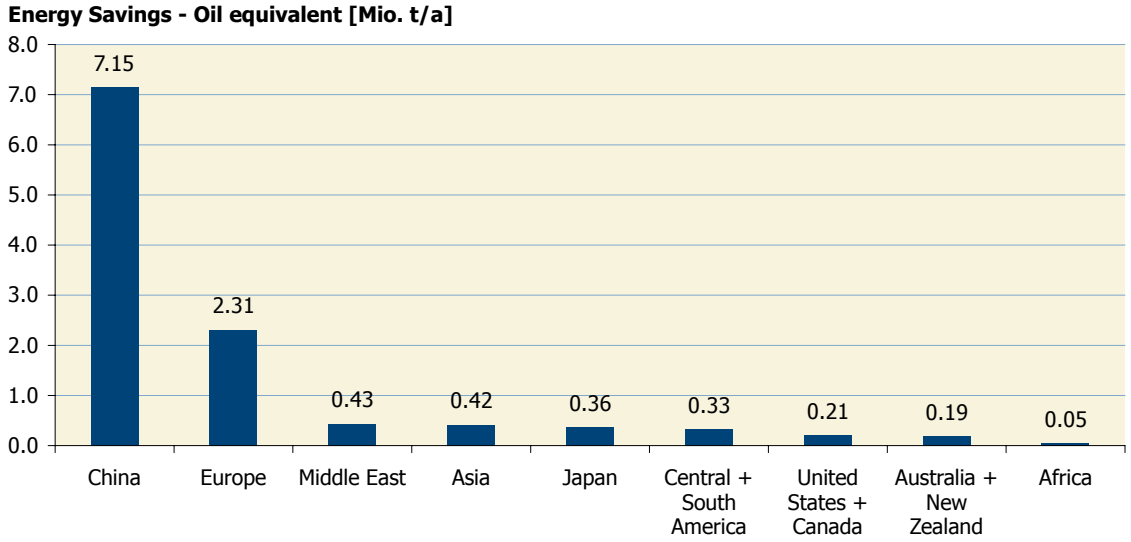
5.2 Energy savings by economic region

5.2.1 Energy savings in oil equivalent by glazed flat-plate and evacuated tube collectors by economic region



Middle East: Israel, Jordan
Africa: Namibia, South Africa, Tunisia, Zimbabwe
Central & South America: Barbados, Brazil, Chile, Mexico, Uruguay
Asia: India, South Korea, Taiwan, Thailand
Europe: EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

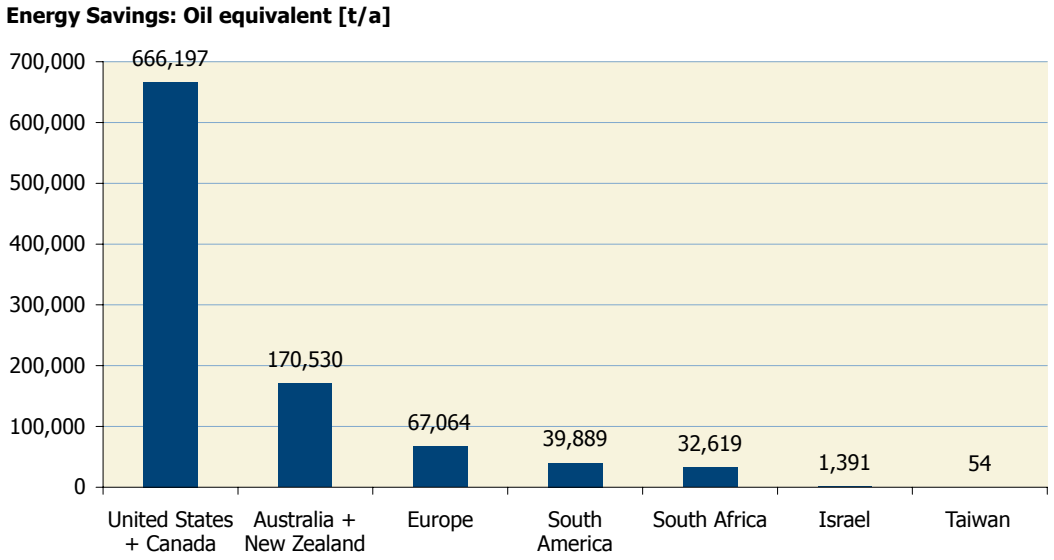
Figure 24: Annual energy savings in oil equivalent by glazed flat-plate and evacuated tube collectors by economic region at the end of 2008



Middle East: Israel, Jordan
Africa: Namibia, South Africa, Tunisia, Zimbabwe
Central & South America: Barbados, Brazil, Chile, Mexico, Uruguay
Asia: India, South Korea, Taiwan, Thailand
Europe: EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

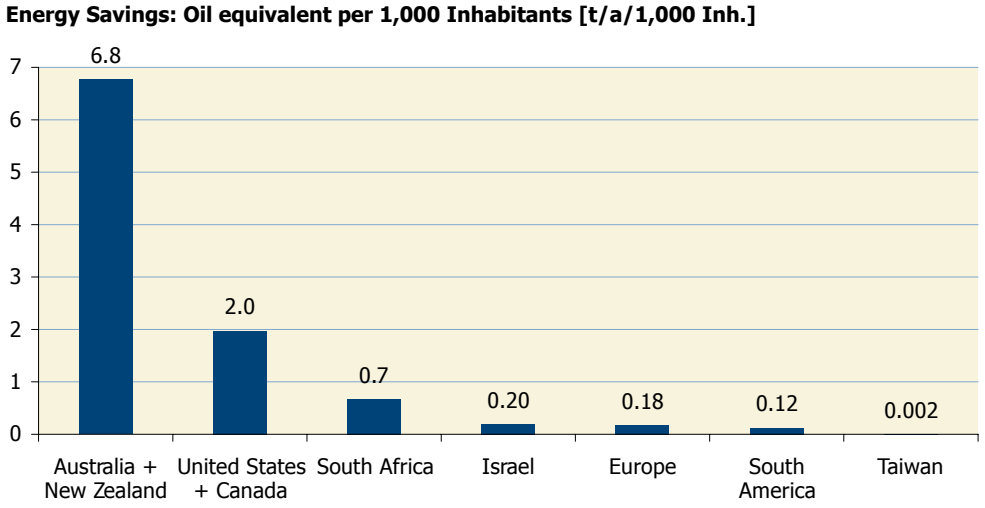
Figure 25: Annual energy savings in oil equivalent by glazed flat-plate and evacuated tube collectors in operation by economic region at the end of 2008 per 1,000 inhabitants

5.2.2 Energy savings in oil equivalent by unglazed collectors by economic region at the end of 2008



South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 26: Annual energy savings in oil equivalent by unglazed collectors by economic region at the end of 2008

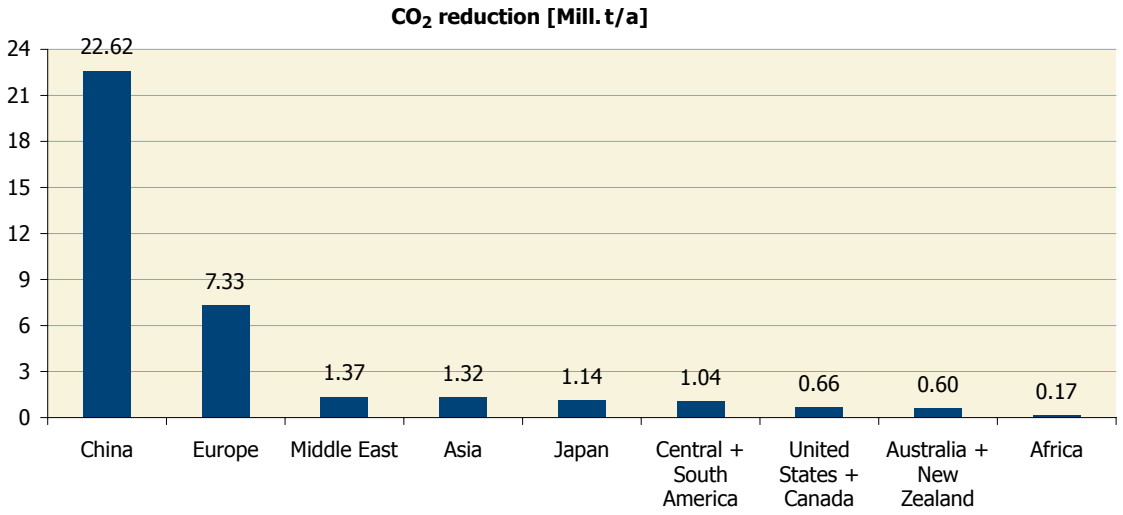


South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 27: Annual energy savings in oil equivalent by unglazed collectors by economic region at the end of 2008 per 1,000 inhabitants

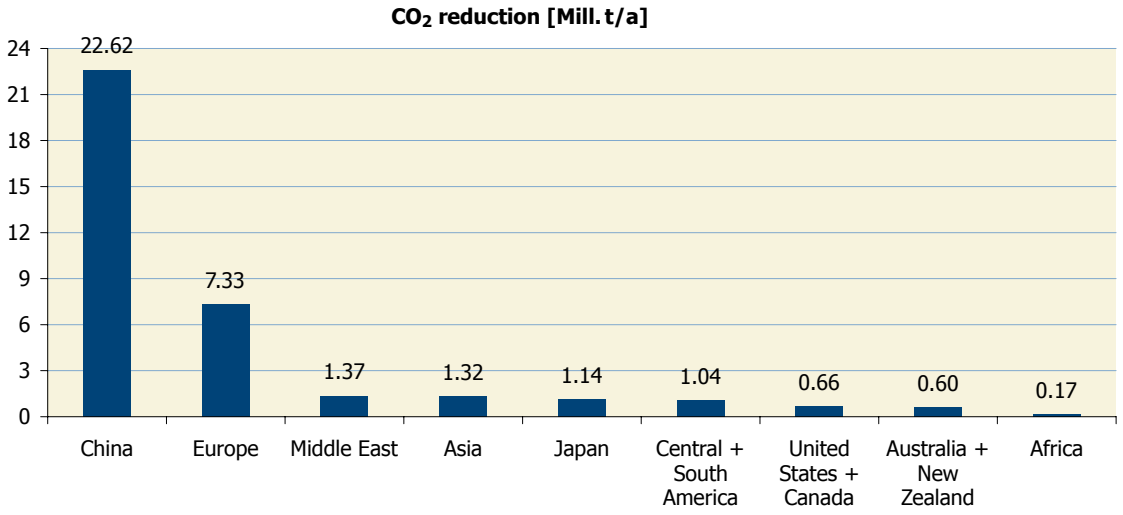
5.3 Contribution to CO_2 reduction by economic region in 2008

5.3.1 Contribution to CO_2 reduction by flat-plate and evacuated tube collectors by economic region in 2008



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

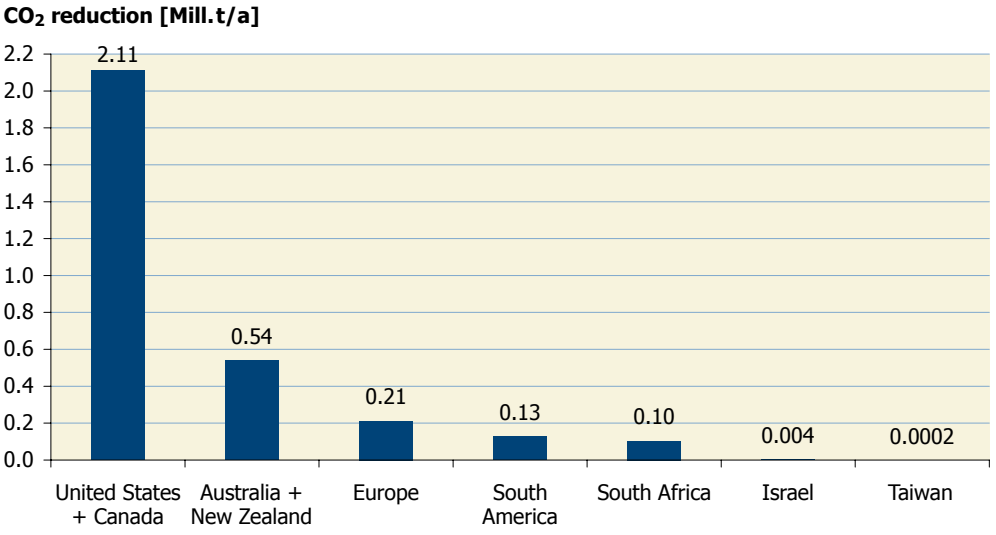
Figure 28: Contribution to CO_2 reduction by flat-plate and evacuated tube collectors by economic region in 2008



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

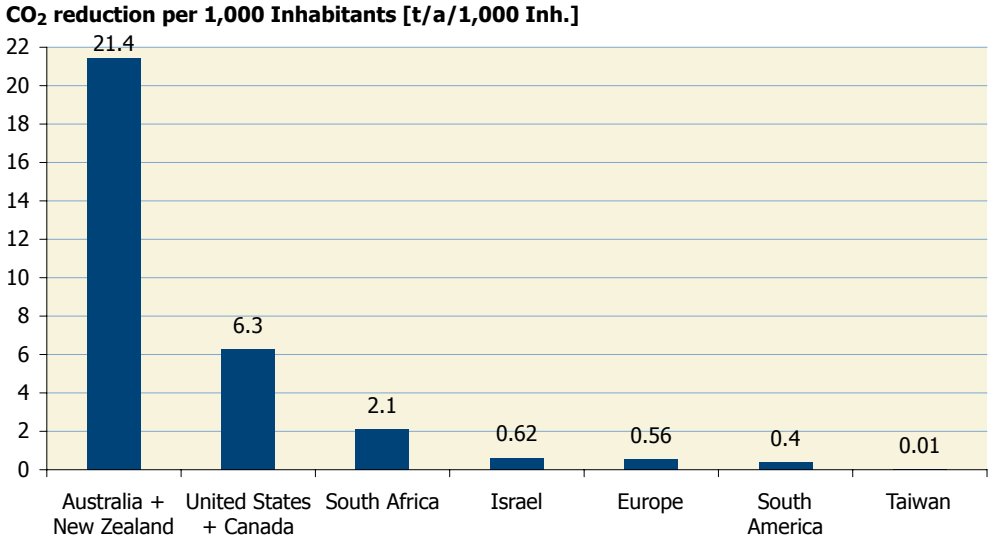
Figure 29: Contribution to CO_2 reduction by flat-plate and evacuated tube collectors by economic region in 2008 per 1,000 inhabitants

5.3.2 Contribution to CO_2 reduction by unglazed collectors by economic region in 2008



South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 30: Contribution to CO_2 reduction by unglazed collectors by economic region in 2008



South America: Brazil, Chile, Mexico
Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland

Figure 31: Contribution to CO_2 reduction by unglazed collectors by economic region in 2008 per 1,000 inhabitants

6 Distribution of systems by application

6.1 Distribution by application—total capacity in operation

If one observes the use of solar thermal energy, it becomes clear that it greatly varies in the different countries. In China, Europe and Japan systems with flat-plate and evacuated tube collectors are mainly used to prepare hot water and to provide space heating while in North America (United States and Canada) swimming pool heating is the dominant application.

Another distinction can be made between pumped systems and thermosiphon systems as shown in **Figure 32**. In the United States, Europe and Australia mainly pumped systems are installed, whereas in Japan, Brazil and China thermosiphon systems are predominant.

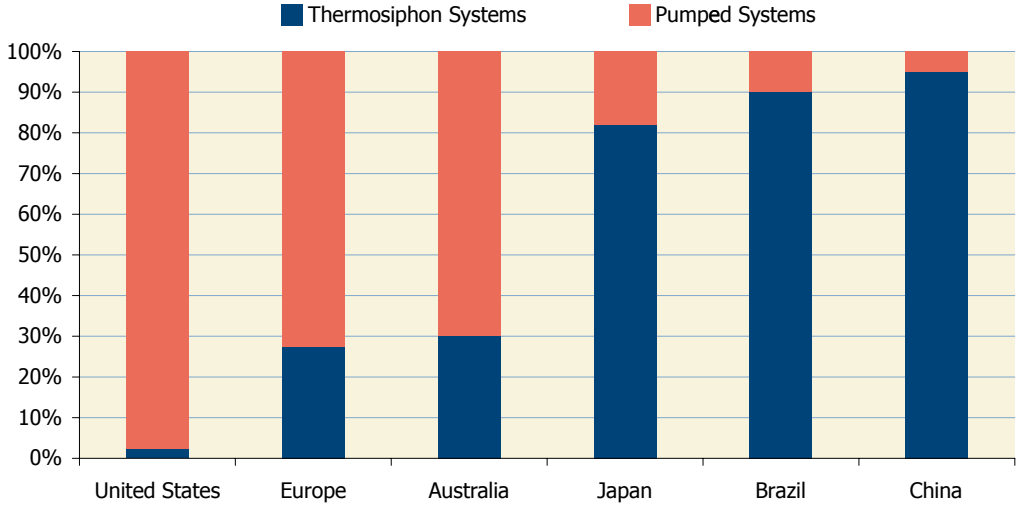
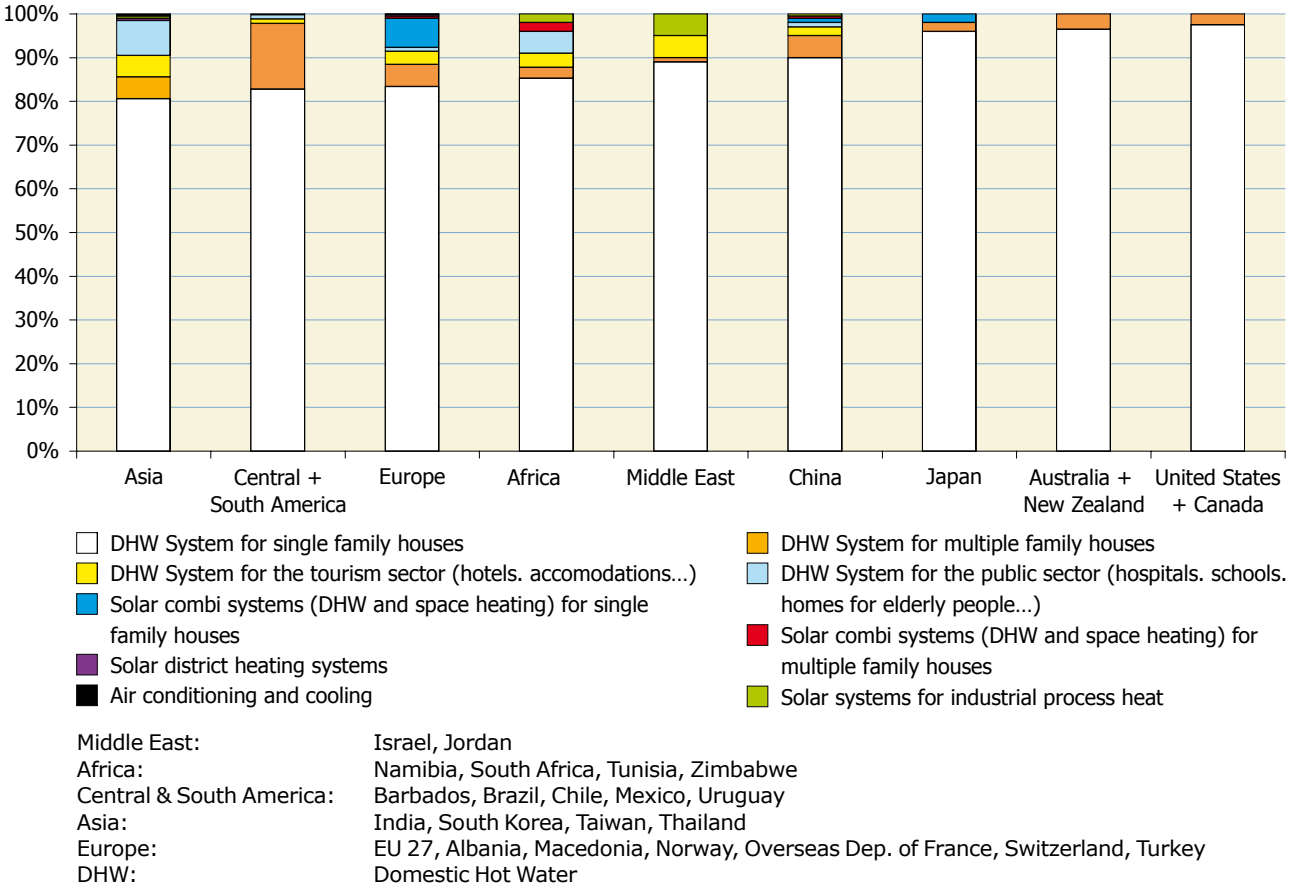


Figure 32: Distribution of different solar thermal systems by economic region for the total capacity in operation of glazed and evacuated tube collectors in 2008

Figure 33 shows the distribution of different applications in the total collector area in operation in the different economic regions. In this figure only applications with glazed flat-plate and evacuated tube collectors have been taken into consideration. Unglazed collectors and air collectors are not included.

The figure shows the dominance of systems that are installed to produce hot water for single-and multi-family houses. In addition, for some Asian, African and South American countries a remarkable amount of hot water systems for the public sector (e.g., hospitals, schools) have been reported.

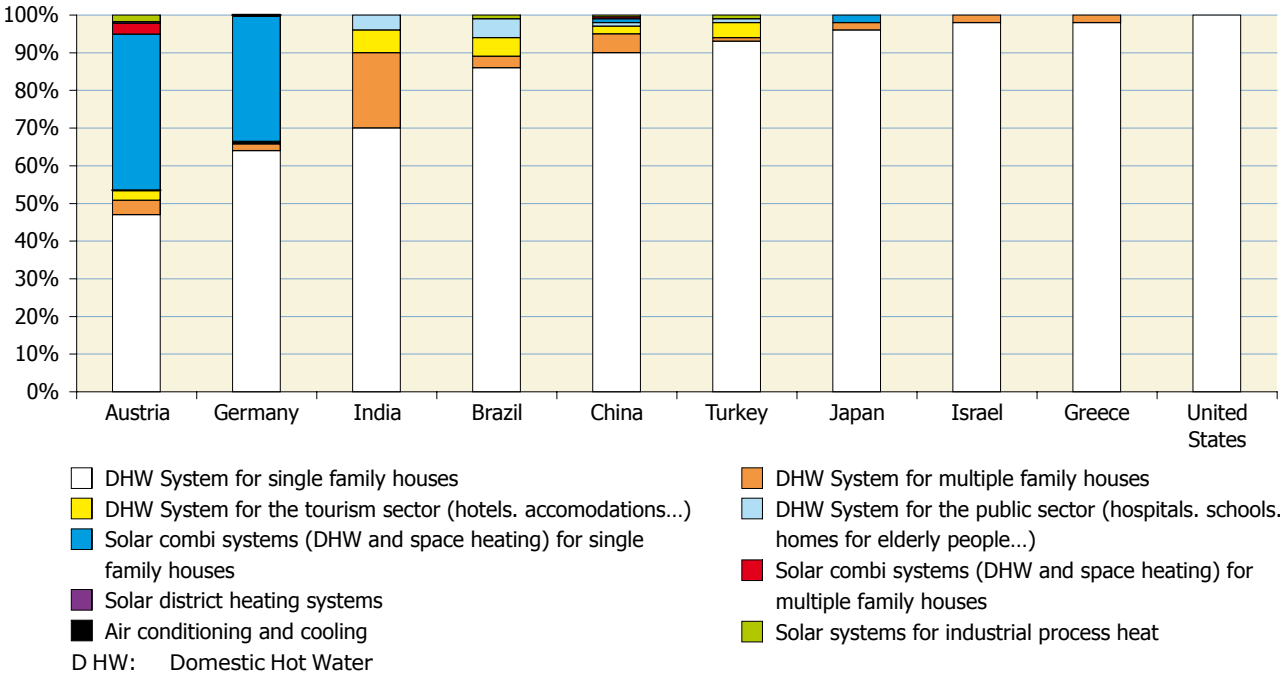
The share of solar combi-systems for hot water preparation and space heating is only relevant in Europe and Japan.



Middle East:	Israel, Jordan
Africa:	Namibia, South Africa, Tunisia, Zimbabwe
Central & South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Asia:	India, South Korea, Taiwan, Thailand
Europe:	EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey
DHW:	Domestic Hot Water

Figure 33: Distribution of different applications by economic region for the total capacity in operation of glazed and evacuated tube collectors in 2008

Figure 34 shows the distribution of different applications for the top 10 countries in the world (in terms of installed capacity of glazed water collectors).



D HW: Domestic Hot Water

Figure 34: Distribution of different applications of the world's top-10-countries related to the total capacity in operation of glazed and evacuated tube collectors in 2008

It is remarkable that in Austria and Germany already about 30% of the overall installations are solar combi-systems.

Worldwide, in Austria, France, Germany, Namibia, Slovenia, Sweden and Switzerland, the share of applications other than hot water preparation is equal to or higher than 15%.

Figure 35 shows the distribution of the applications for the 10 countries in Europe with the largest collector areas in operation.

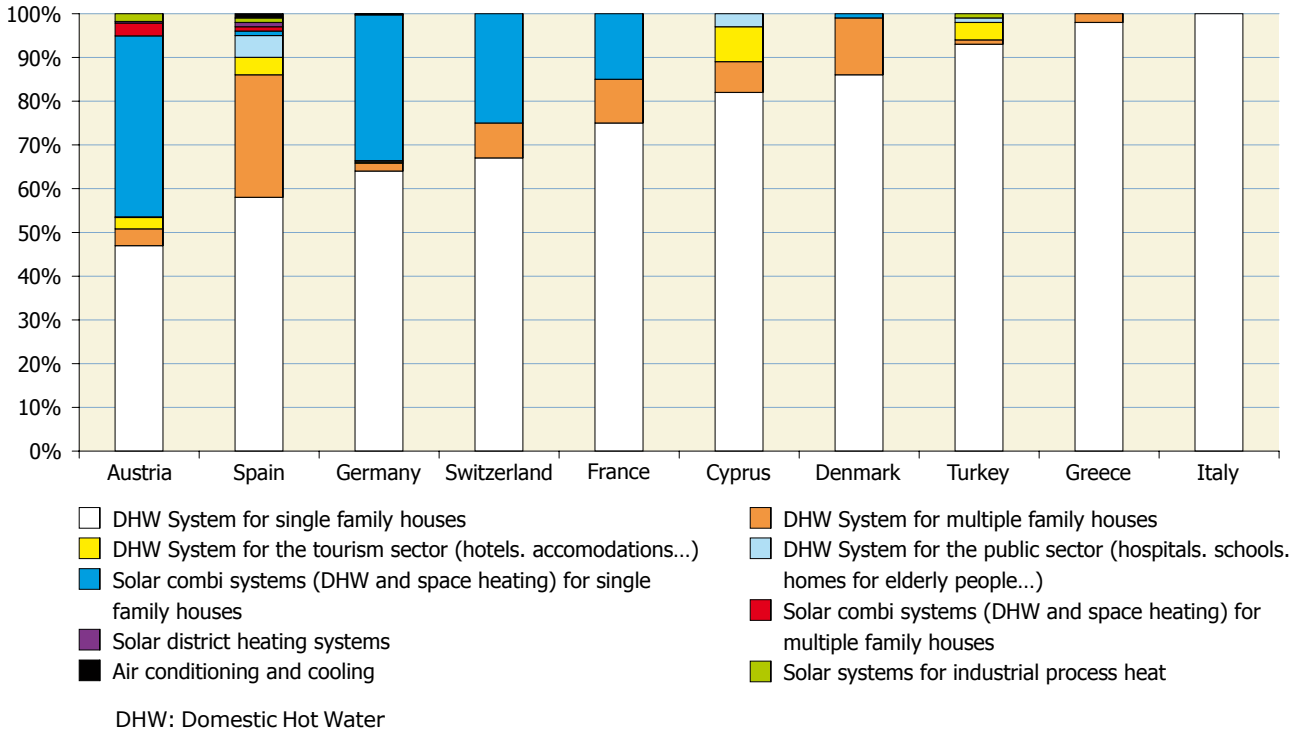


Figure 35: Distribution of different applications in the European top-10-countries related to the total capacity in operation of glazed and evacuated tube collectors in 2008

Spain, Austria and Germany have the most sophisticated markets for different solar thermal applications. It includes systems for hot water preparation, systems for space heating of single- and multi-family houses and hotels, large-scale plants for district heating as well as a growing number of systems for air conditioning, cooling and industrial applications.

In general the large markets in Europe tend to become more sophisticated as a result of continuous R&D activities. This can also be seen in **Figure 36**.

6.2 Distribution by application—systems installed in 2008

In this chapter, the distribution of different solar thermal applications for newly installed systems in 2008 is presented. **Figure 36** shows the distribution of different applications newly installed in 2008 by selected economic regions for glazed and evacuated tube collectors.

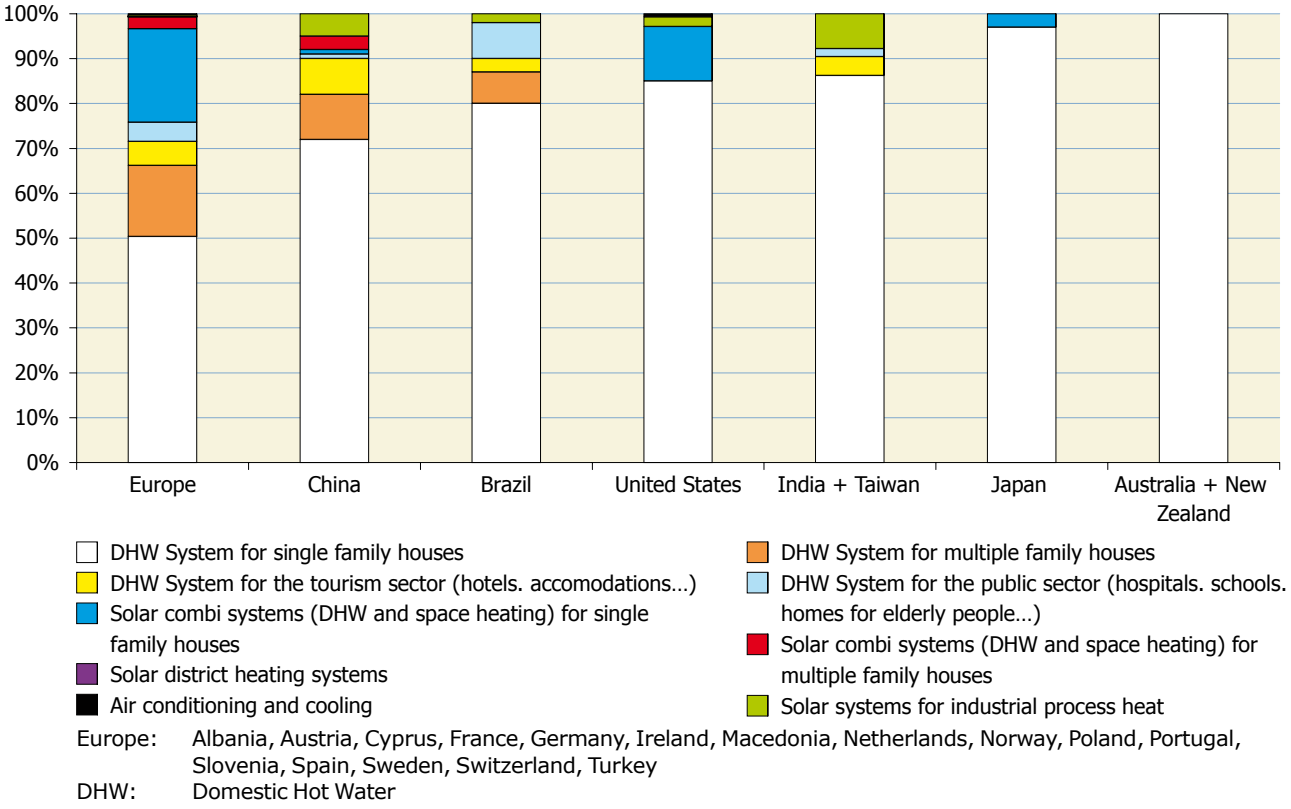


Figure 36: Distribution of different applications newly installed in 2008 by economic region for glazed and evacuated tube collectors

Figure 36 shows the dominance of systems installed to produce hot water for single-family houses. However, in Europe there were almost as many conventional domestic hot water installations than installations for other applications. This development can be explained by analyzing the top 8 markets of new installations in 2008 as shown in **Figure 37**.

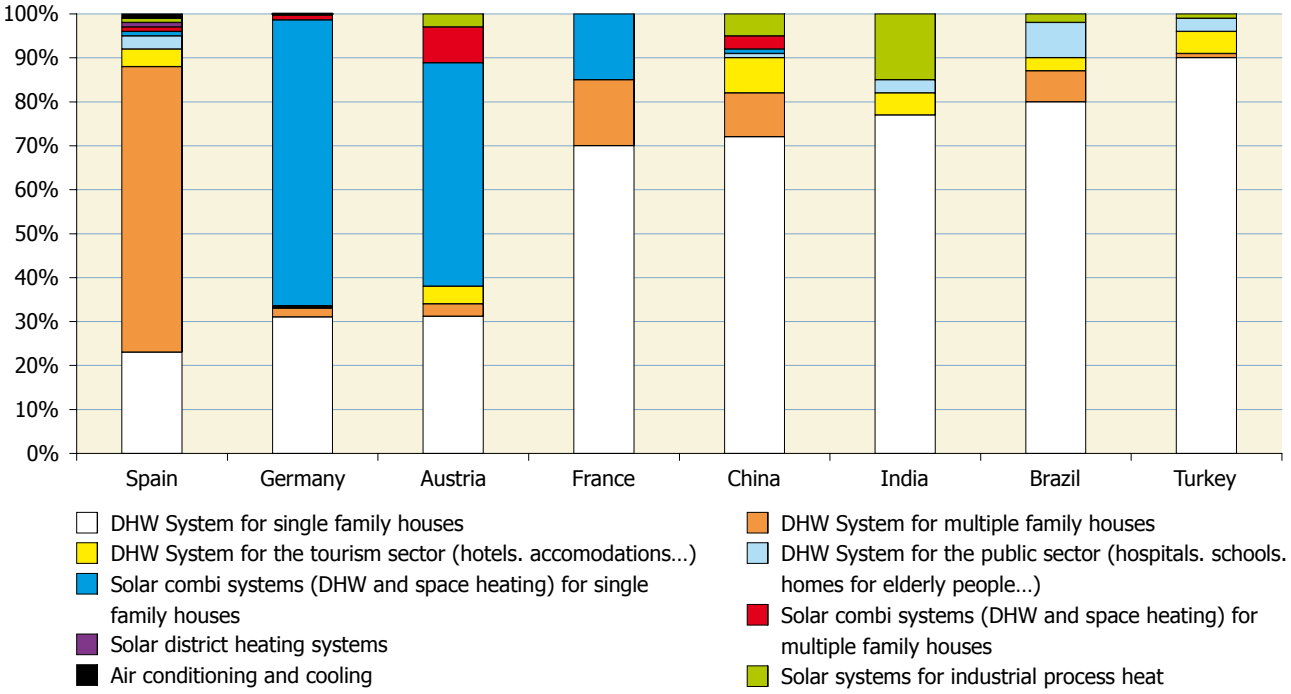


Figure 37: Distribution of different applications of the world's top-8-countries related to the newly installed capacity of glazed and evacuated tube collectors in 2008

It is notable that in the large European solar thermal markets, Spain, Germany and Austria domestic hot water systems only accounted for about 30% or less of the total installed systems in 2008.

7 Appendix

7.1 Methodological approach for the energy calculation

In order to obtain the energy yield of thermal solar plants, the oil equivalent saved and the CO_2 emissions avoided, the following procedure was used:

- Only water collectors were used for the calculations (unglazed, flat-plate and evacuated tube collectors). Air collector plants were not considered.
- For each country, the overall collector area installed (water collectors) was allocated to the four plant types:
  - Solar thermal systems for swimming pool heating with unglazed collectors
  - Solar domestic hot water systems for single family houses
  - Solar domestic hot water systems for multi-family houses, hotels and district heating
  - Solar combi systems[2] for domestic hot water and space heating for single and multiple family houses
- Reference plants were defined for each country and for each type of plant.
- The number of plants for each country was determined from the share of collector area for each plant type and the collector area per reference system.

Reference collectors and a reference climate were determined for each country apart from the reference plants. On the basis of these reference conditions, simulations were performed with the simulation program T-Sol [T-Sol, Version 4.5 Expert, Valentin Energiesoftware, www.valentin.de] to obtain the solar yields, energy savings and CO_2 emissions.

The annual collector yield per square meter of collector area, depending on the application (swimming pool heating, domestic hot water preparation, space heating etc.), the local climatic conditions and the plant dimensions (high or low solar fraction) was calculated for each country and each system. The energy savings were obtained from the energy equivalent of the fuel used and the rate of efficiency of the auxiliary heating system.

For the auxiliary heating system, oil was taken as the fuel for all plants and the energy equivalent per liter of fuel oil 38,052 kJ (higher heating value) respectively 10.57 kWh was used in all countries in order to achieve comparable results.

To obtain an exact statement about the CO_2 emissions avoided, the substituted energy medium would have to be ascertained for each country. Since this could only be done in a very detailed survey, which goes beyond the scope of this report, the energy savings and the CO_2 emissions avoided relate to fuel oil.

It is obvious that not all solar thermal systems worldwide just replace systems running on oil. This represents a simplification since gas, coal, biomass or electricity can be used as the energy source for the auxiliary heating system instead of oil.

The CO_2 emissions avoided by solar systems were ascertained from the energy savings (oil equivalent). As the emission factor 2.79 kg CO_2 / l was used.

The following tables describe the key data of the reference systems in the different countries, the location of the reference climate used and the share of the total collector area in use for the respective application. Furthermore, a hydraulic scheme is shown for each reference system.

2 Solar combi-systems are solar heating installations that provide space heating and domestic hot water.

7.1.1 Solar thermal systems for swimming pool heating with unglazed collectors

Country	Reference climate	Collector area (gross area) for single system [m²]	Total collector area unglazed 2008 [m²]	Total number of systems unglazed 2008
Australia	Sydney	200	4,100,000	19,680
Austria	Graz	200	624,110	3,121
Belgium	Brussels	200	46,875	234
Brazil	Brasília	200	802,830	4,014
Canada	Montreal	200	725,277	3,626
Chile	Santiago de Chile	200	1,470	7
Czech Republic	Praha	200	14,621	73
Denmark	Copenhagen	200	20,515	103
Finland	Helsinki	200	11,779	59
France	Paris	200	100,320	502
Germany	Würzburg	200	720,000	3,600
Hungary	Budapest	200	2,688	13
Israel	Jerusalem	200	26,700	134
Italy	Bologna	200	25,219	126
Mexico	Mexico City	200	496,591	2,483
Netherlands	Amsterdam	200	360,815	1,804
New Zealand	Wellington	200	6,544	33
Norway	Oslo	200	1,709	9
Poland	Warsaw	200	1,248	6
Portugal	Lisbon	200	1,340	7
South Africa	Johannesburg	200	699,678	3,498
Spain	Madrid	200	86,400	432
Sweden	Gothenburg	200	105,000	504
Switzerland	Zürich	200	211,800	1,059
Taiwan	Taipei	200	1,860	9
United States	Indianapolis, Los Angeles	200	17,727,143	88,636
TOTAL			**26,922,531**	**133,772**

* countries not listed in this table: no reliable database for unglazed collectors available

Table 8: Solar thermal swimming pool heating reference systems* and the total collector area in operation in 2008 (unglazed water collectors)

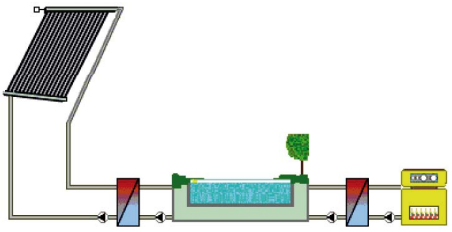


Figure 38: Hydraulic scheme of the swimming pool reference system

7.1.2 Solar domestic hot water systems for single family houses

The market share in the following table refers to the total capacity in operation of flat-plate and evacuated tube collectors at the end of 2008 for each country. It must be pointed out that the market share of the new installed capacity in the year 2008 can differ significantly from the total market share.

Country	Reference climate	Collector area [m²]		Share of DHW-SFH [%]	Number of systems DHW-SFH	Hot water		Storage capacity [l]	System
		for single system	total of DHW-SFH 2008			demand [l/d]	temp. [°C]		
Albania	Tirana	2.5	14,981	26	5,992	150	60	150	TS
Australia	Sydney	4.0	1,958,040	98	489,510	170	60	300	PS
Austria	Graz	6.0	2,070,951	62	345,159	150	60	300	PS
Barbados	Grantley Adams	4.0	82,104	100	20,526	150	60	200	TS
Belgium	Brussels	4.0	227,633	100	56,908	150	60	200	PDS
Brazil	Brasília	4.0	3,001,724	86	750,431	150	60	200	TS
Bulgaria	Sofia	4.0	21,619	71	5,405	150	60	200	PS
Canada	Montreal	6.0	91,891	95	15,315	150	60	200	PS
Chile	Santiago de Chile	4.0	17,730	100	4,433	150	60	200	PS
China	Shanghai	4.0	112,500,000	90	28,125,000	150	60	200	TS

Country	Reference climate	Collector area [m²]		Share of DHW-SFH [%]	Number of systems DHW-SFH	Hot water		Storage capacity [l]	System
		for single system	total of DHW-SFH 2008			demand [l/d]	temp. [°C]		
Cyprus	Nicosia	4.0	658,886	82	164,722	150	60	200	TS
Czech Republic	Praha	6.0	140,260	99	23,377	150	60	300	PS
Denmark	Copenhagen	4.0	355,223	86	88,806	150	60	200	PS
Estonia	Tallin	4.0	1,891	100	473	150	60	200	PS
Finland	Helsinki	4.0	23,238	95	5,809	150	60	200	PS
France	Paris	4.0	1,324,440	75	331,110	150	60	200	PS
Germany	Würzburg	6.0	6,603,618	64	1,100,603	150	60	300	PS
Greece	Athens	4.0	3,792,600	98	948,150	150	60	200	TS
Hungary	Budapest	6.0	52,177	99	8,696	150	60	300	PS
India	Neu-Delhi	4.0	1,771,837	70	442,959	150	60	200	TS
Ireland	Dublin	4.0	67,649	89	16,912	150	60	200	PS
Israel	Jerusalem	4.0	3,697,420	98	924,355	150	60	200	TS
Italy	Bologna	4.0	1,449,600	100	362,400	150	60	200	PS
Japan	Tokyo	4.0	5,638,698	96	1,409,675	150	60	200	TS
Jordan	Amman	4.0	714,452	80	178,613	150	60	200	TS
South Korea	Seoul	4.0	771,030	54	192,758	150	60	200	PS
Lativa	Riga	4.0	6,864	100	1,716	150	60	200	PS
Lithuania	Vilnius	4.0	4,118	100	1,030	150	60	200	PS
Luxembourg	Luxembourg	4.0	21,600	100	5,400	150	60	200	PS
Macedonia	Skopje	4.0	19,331	85	4,833	150	60	200	PS
Malta	Luqa	4.0	33,946	100	8,486	150	60	200	PS
Mexico	Mexico City	4.0	150,481	28	37,620	150	60	200	PS
Namibia	Windhoek	4.0	2,967	44	742	150	60	200	TS
Netherlands	Amsterdam	3.0	284,629	83	94,876	110	60	100	PDS
New Zealand	Wellington	4.0	121,606	95	30,401	170	60	300	PS
Norway	Oslo	6.0	11,863	98	1,977	150	60	300	PS
Poland	Warsaw	6.0	227,279	65	37,880	150	60	300	PS
Portugal	Lisbon	4.0	335,190	95	83,797	150	60	200	PS
Romania	Bucharest	4.0	74,496	100	18,624	150	60	200	PS
Slovak Republic	Bratislava	6.0	107,246	100	17,874	150	60	300	PS
Slovenia	Ljubjana	6.0	101,839	83	16,973	150	60	300	PS
South Africa	Johannesburg	4.0	275,682	100	68,920	150	60	200	TS
Spain	Madrid	4.0	902,016	58	225,504	150	60	200	PS
Sweden	Gothenburg	6.0	27,600	10	4,600	150	60	300	PS
Switzerland	Zürich	6.0	361,740	67	60,290	150	60	300	PS
Taiwan	Taipei	4.0	1,667,709	98	416,927	150	60	200	TS
Thailand	Bangkok	4.0	76,742	100	19,185	150	60	200	TS
Tunisia	Tunis	4.0	277,498	97	69,374	150	60	200	TS
Turkey	Ankara	4.0	9,892,224	93	2,473,056	150	60	200	TS
United Kingdom	London	4.0	370,483	100	92,621	150	60	200	PS
United States	Indianapolis, Los Angeles	6.0	2,724,910	100	454,152	150	60	200	PS
Uruguay	Montevideo	4.0	4,861	100	1,215	150	60	200	PS
Zimbabwe	Harare	4.0	17,316	100	4,329	150	60	200	PS
TOTAL			**165,151,927**		**40,270,500**				

DHW-SFH: domestic hot water systems for single family houses
PS: pumped system
TS: thermo siphon system
PDS: pumped drain back system
Auxiliary heating device: oil boiler

Table 9: Domestic hot water reference systems for single family houses and the total collector area in operation in 2008 (flat-plate and evacuated tube collectors)

Next, **Figure 39** shows the hydraulic scheme used for the energy calculation for all pumped solar thermal systems and **Figure 40** refers to the thermosiphon systems.

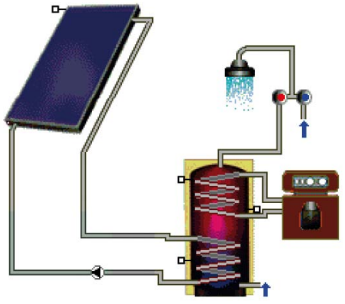


Figure 39 : Hydraulic scheme of the DHW pumped reference system

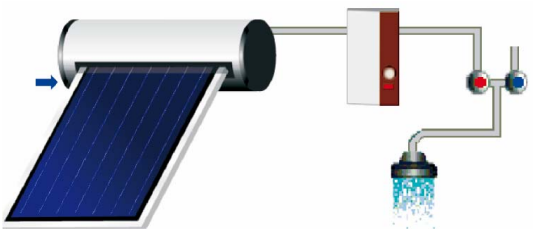


Figure 40 : Hydraulic scheme of the DHW thermosiphon reference system

For the Chinese thermosiphon systems, the same reference system was used but instead of flat plate collectors as shown in **Figure 40** a typical vacuum tube collector was used for the simulation.

7.1.3 Solar domestic hot water systems for multi-family houses, hotels and district heating

The market share in the **Table 10** refers to the total capacity in operation of flat-plate and evacuated tube collectors at the end of 2008 for each country. It must be pointed out that the market share of the new installed capacity in the year 2008 can differ greatly from the total market share.

Country	Reference climate	Collector area [m²]		Share of DHW-MFH [%]	Number of systems DHW-MFH	Hot water		Storage capacity [l]	System
		for single system	total of DHW-MFH 2008			demand [l/d]	temp. [°C]		
Albania	Tirana	50	42,638	74	853	2000	60	2500	PS
Australia	Sydney	50	38,362	2	767	2000	60	2500	PS
Austria	Graz	50	334,024	10	6,680	2000	60	2500	PS
Brazil	Brasília	50	488,653	14	9,773	2000	60	2500	PS
Bulgaria	Sofia	50	8,717	29	174	2000	60	2500	PS
Canada	Montreal	50	4,836	5	97	2000	60	2500	PS
China	Shanghai	50	10,625,000	9	212,500	2000	60	2500	PS
Cyprus	Nicosia	50	144,634	18	2,893	2000	60	2500	PS
Czech Republic	Praha	50	1,417	1	28	2000	60	2500	PS
Denmark	Copenhagen	50	53,696	13	1,074	2000	60	2500	PS
Finland	Helsinki	50	1,223	5	24	2000	60	2500	PS
France	Paris	50	176,592	10	3,532	2000	60	2500	PS
Germany	Würzburg	50	257,954	3	5,159	2000	60	2500	PS
Greece	Athens	50	74,323	2	1,486	2000	60	2500	PS
Hungary	Budapest	50	527	1	11	2000	60	2500	PS
India	Neu-Delhi	50	759,359	30	15,187	2000	60	2500	PS
Ireland	Dublin	50	3,040	4	61	2000	60	2500	PS
Israel	Jerusalem	50	75,458	2	1,509	2000	60	2500	PS
Japan	Tokyo	50	117,473	2	2,349	2000	60	2500	PS
Jordan	Amman	50	171,468	20	3,429	2000	60	2500	PS
South Korea	Seoul	50	656,804	46	13,136	2000	60	2500	PS
Macedonia	Skopje	50	3,411	15	68	2000	60	2500	PS
Mexico	Mexico City	50	382,112	72	7,642	2000	60	2500	PS
Namibia	Windhoek	50	3,236	48	65	2000	60	2500	PS
Netherlands	Amsterdam	50	40,656	12	813	2000	60	2500	PDS
New Zealand	Wellington	50	6,400	5	128	2000	60	2500	PS
Norway	Oslo	50	121	1	2	2000	60	2500	PS
Poland	Warsaw	50	104,898	30	2,098	2000	60	2500	PS
Portugal	Lisbon	50	17,642	5	353	2000	60	2500	PS
Slovenia	Ljubjana	50	2,454	2	49	2000	60	2500	PS
Spain	Madrid	50	622,080	40	12,442	2000	60	2500	PS
Sweden	Gothenburg	50	39,744	15	795	2000	60	2500	PS
Switzerland	Zürich	50	43,193	8	864	2000	60	2500	PS
Taiwan	Taipei	50	28,117	2	562	2000	60	2500	PS
aautoTunisia	Tunis	50	8,582	3	172	2000	60	2500	PS
Turkey	Ankara	50	744,576	7	14,892	2000	60	2500	PS
TOTAL			**16,083,421**		**321,668**				

DHW-MFH: domestic hot water systems for multi family houses, PS: pumped system, Auxiliary heating device: oil boiler

Table 10: Domestic hot water reference systems for multi-family houses, hotels and district heating and the total collector area in operation in 2008 (flat-plate and evacuated tube collectors)

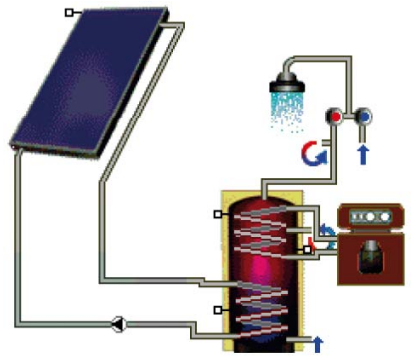


Figure 41: Hydraulic scheme of the DHW system for multi family houses

7.1.4 Solar combi-systems for domestic hot water and space heating for single family houses

The market share of combi-systems in the following table refers to the total capacity in operation of flat-plate and evacuated tube collectors at the end of 2008 for each country. It must be pointed out that the market share of the new installed capacity in the year 2008 can differ significantly from the total market share. The reference system is designed for a single-family house with 140 m² gross area.

Country	Reference climate	Collector area [m²]		Share of CS (2010) [%]	Number of CS 2008	Storage capacity [l]	Space heat demand [kWh/m²·a]	System
		for single system	total of DHW-SFH 2008					
Austria	Graz	15.00	935,268	28	62,351	2,000	80	PS
China	Shanghai	12.00	1,875,000	2	156,250	800	80	PS
Denmark	Copenhagen	12.00	4,130	1	344	800	100	PS
France	Paris	15.00	264,888	15	17,659	1,000	80	PS
Germany	Würzburg	12.00	3,456,582	34	288,048	800	80	PS
Ireland	Dublin	12.00	5,321	7	443	1,000	100	PS
Japan	Tokyo	12.00	117,473	2	9,789	800	80	PS
Namibia	Windhoek	12.00	539	8	45	800	8	PS
Netherlands	Amsterdam	6.00	17,146	5	2,858	500	80	PS
Norway	Oslo	12.00	121	1	10	1,000	100	PS
Poland	Warsaw	12.00	17,483	5	1,457	1,000	100	PS
Slovenia	Ljubjana	12.00	18,405	15	1,534	800	80	PS
Spain	Madrid	12.00	31,104	2	2,592	800	80	PS
Sweden	Gothenburg	12.00	198,720	75	16,560	1,000	100	PS
Switzerland	Zürich	12.00	134,978	25	11,248	800	80	PS
TOTAL			**7,077,158**		**571,189**			

CS = Combi Systems: systems for the supply of hot water and space heating, PS: pumped system, Auxiliary heating device: oil boiler;

Table 11: Reference systems for combi-systems for single-family houses and the percentage of the total collector area in operation (flat-plate and evacuated tube collectors)

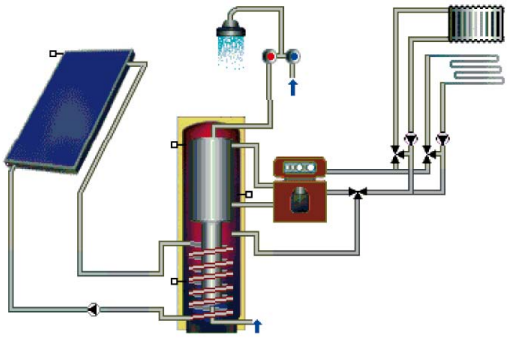


Figure 42: Hydraulic scheme of the solar combi reference system

7.2 Reference collector

7.2.1 Data of the reference absorber for swimming pool heating

$\eta = 0.85$

a1 = 20 [W/m²K]

a2 = 0.1 [W/m² K²]

7.2.2 Data of the reference collector for all other applications except for China

$\eta = 0.8$

a1 = 3.69 [W/m²K]

a2 = 0.007 [W/m² K²]

7.2.3 Data of the Chinese reference vacuum tube collector

$\eta = 0.74$

a1 = 2.5 [W/m²K]

a2 = 0.013 [W/m² K²]

7.3 Reference climates

Country	Reference climate	Horizontal irradiation G0 [kWh/m²*a]	Avg. Outside air temp. [°C]
Albania	Tirana	1,604.3	13.5
Australia	Sydney	1,674.0	18.1
Austria	Graz	1,126.0	9.2
Barbados	Grantley Adams	2,016.3	27.4
Belgium	Brussels	971.1	10.0
Brazil	Brasília	1,792.5	22.0
Bulgaria	Sofia	1,187.5	10.1
Canada	Montreal	1,351.4	6.9
Chile	Santiago de Ch.	1,752.7	14.5
China	Shanghai	1,281.9	17.1
Cyprus	Nicosia	1,885.5	19.9
Czech Republic	Praha	998.4	7.9
Denmark	Copenhagen	989.4	8.1
Estonia	Tallin	960.2	5.3
Finland	Helsinki	948.0	4.6
France	Paris	1,112.4	11.0
Germany	Würzburg	1,091.3	9.5
Greece	Athens	1,584.6	18.5
Hungary	Budapest	1,198.7	11.0
India	Neu-Delhi	1,960.5	24.7
Ireland	Dublin	948.7	9.5
Israel	Jerusalem	2,198.0	17.3
Italy	Bologna	1,419.0	14.3
Japan	Tokyo	1,175.2	16.7
Jordan	Amman	2,145.4	17.9
South Korea	Seoul	1,161.1	12.7
Latvia	Riga	991.2	6.3

Country	Reference climate	Horizontal irradiation G0 [kWh/m²*a]	Avg. Outside air temp. [°C]
Lithuania	Vilnius	1,001.2	6.2
Luxembourg	Luxembourg	1,037.4	8.4
Macedonia	Skopje	1,380.8	12.5
Malta	Luqa	1,901.9	18.7
Mexico	Mexico City	1,706.3	16.6
Namibia	Windhoek	2363	21.0
Netherlands	Amsterdam	999.0	10.0
New Zealand	Wellington	1,401.2	13.6
Norway	Oslo	971.1	5.8
Poland	Warsaw	1,024.2	8.1
Portugal	Lisbon	1,686.4	17.4
Romania	Bucharest	1,324.3	10.6
Slovak Rep.	Bratislava	1,213.8	10.3
Slovenia	Ljubjana	1,114.6	9.8
South Africa	Johannesburg	2,075.1	15.6
Spain	Madrid	1,643.5	15.5
Sweden	Gothenburg	933.9	7.2
Switzerland	Zürich	1,093.8	9.6
Taiwan	Taipei	1,372.2	20.8
Thailand	Bangkok	1,764.8	29.1
Tunisia	Tunis	1,808.2	19.3
Turkey	Ankara	1,700.9	12.0
UK	London	942.6	12.0
United States	Indianapolis Los Angeles	1,492.3 1,799.8	11.3 17.2
Uruguay	Montevideo	1,534.2	15.9
Zimbabwe	Harare	2,017.1	18.9

Table 12: Reference climates for the 53 countries surveyed

7.4 Population data

Country	2008
Albania	3,619,778
Australia	21,007,310
Austria	8,205,533
Barbados	283,498
Belgium	10,403,951
Brazil	196,342,587
Bulgaria	7,262,675
Canada	33,212,696
Chile	16,454,143
China	1,317,065,677
Cyprus	1,066,817
Czech Republic	10,220,911
Denmark	5,484,723
Estonia	1,307,605
Finland	5,244,749
France	64,057,790
Germany	82,369,548
Greece	10,722,816
Hungary	9,930,915

Country	2008
India	1,140,566,211
Ireland	4,156,119
Israel	7,112,359
Italy	58,145,321
Japan	127,288,419
Jordan	6,132,625
South Korea	48,379,392
Latvia	2,245,423
Lithuania	3,565,205
Luxembourg	486,006
Macedonia	2,061,315
Malta	403,532
Mexico	109,955,400
Namibia	2,088,669
Netherlands	16,645,313
New Zealand	4,173,460
Norway	4,644,457
Poland	38,500,696
Portugal	10,676,910

Country	2008
Romania	22,246,862
Slovak Republic	5,455,407
Slovenia	2,007,711
South Africa	48,782,755
Spain	40,491,051
Sweden	9,045,389
Switzerland	7,581,520
Taiwan	22,920,946
Thailand	65,578,534
Tunisia	10,383,577
Turkey	75,793,836
United Kingdom	60,943,912
United States	304,059,724
Uruguay	3,477,778
Zimbabwe	11,350,111

Σ Solar Thermal World Statistic	4,081,609,667
Σ Inhabitants world	6,681,112,529

Data source: International Data Base of the U.S. Census Bureau http://www.census.gov/ipc/www/idb/country.php

Table 13: Inhabitants of the 53 surveyed countries in alphabetic order

	Inhabitants	Share
United States+Canada	337,272,420	8.3%
Japan	127,288,419	3.1%
China	1,317,065,677	32.3%
Europe	584,993,796	14.3%
Australia + New Zealand	25,180,770	0.6%

	Inhabitants	Share
Asia	1,277,445,083	31.3%
Central and South America	326,513,406	8.0%
Africa	72,605,112	1.8%
Middle East	13,244,984	0.3%
TOTAL	**4,081,609,667**	**100%**

Data source: International Data Base of the U.S. Census Bureau http://www.census.gov/ipc/www/idb/country.php

Middle East: Israel, Jordan
Africa: Namibia, South Africa, Tunisia, Zimbabwe
Central & South America: Barbados, Brazil, Chile, Mexico, Uruguay
Asia: India, South Korea, Taiwan, Thailand
Europe: EU 27, Albania, Macedonia, Norway, Overseas Dep. of France, Switzerland, Turkey

Table 14: Inhabitants per economic region

7.5 Market data of the previous years

The data presented in Chapters 3 through 5 were originally collected in square meters. Through an agreement of international experts the collector areas of these solar thermal applications have been converted and are shown in installed capacity.

Making the installed capacity of solar thermal collectors comparable with that of other energy sources, solar thermal experts from seven countries agreed upon a methodology to convert installed collector area into solar thermal capacity.

The methodology was developed during a meeting with IEA SHC Programme and major solar thermal trade associations in Gleisdorf, Austria in September 2004. The represented associations from Austria, Canada, Germany, the Netherlands, Sweden and the United States as well as the European Solar Thermal Industry Federation (ESTIF) and the IEA SHC Programme agreed to use a factor of 0.7 kW_{th}/m2 to derive the nominal capacity from the area of installed collectors.

Nevertheless, solar thermal collectors are traditionally quoted in square meters and therefore **Table 15** and **Table 16** provide the 2006 and 2007 data in m² as well as the total installed collector area in 2007 (**Table 17**).

The following tables containing data for 2006 and 2007 may deviate from data provided in the previous reports. Due to more detailed investigations in several countries updated data were provided. The main differences to previous years result from either corrected country specific data (e.g. China, India) or from solar thermal collector replacements in the total number of systems installed (e.g. China, Israel, USA).

Country	Water Collectors			Air Collectors		TOTAL [m²]
	Unglazed*	Glazed*	evacuated tube*	Unglazed*	Glazed*	
Albania		7,960	76			**8,036**
Australia	550,000	156,000	15,000			**721,000**
tlparAustria	6,935	289,745	2,924			**299,604**
Barbados		2,731				**2,731**
Belgium	8,828	31,267	4,369			**44,464**
Brazil	57,873	434,331				**492,204**
Bulgaria		2,200				**2,200**
Canada	36,292	1,312	712	23,441	38	**61,795**
Chile		7,043				**7,043**
China		900,000	17,100,000			**18,000,000**
Cyprus		60,000				**60,000**
Czech Republic	6,000	18,490	3,540			**28,030**
Denmark	1,600	28,500	1,000		7,000	**38,100**
Estonia		300				**300**
Finland		3,400				**3,400**
France	6,000	284,000	11,000			**301,000**
Germany	30,000	1,350,000	150,000		5,400	**1,535,400**
Greece		249,000				**249,000**
Hungary		1,000				**1,000**
India		340,410			5,000	**345,410**
Ireland		4,100	900			**5,000**
Israel	3,800	222,000				**225,800**
Italy	3,650	155,798	26,552			**186,000**
Japan		262,665	1,382	17,436		**281,483**
Jordan		7,666	3,600			**11,266**
Korea		29,043				**29,043**
Latvia		1,200				**1,200**
Lithuania		600				**600**
Luxembourg		2,500				**2,500**
Macedonia		2,118	36			**2,154**
Malta		4,500				**4,500**
Mexico	29,029	67,735				**96,764**
Namibia		1,720				**1,720**
Netherlands	24,419	14,937				**39,356**
New Zealand	600	9,600	3,350			**13,550**
Norway		700	100			**800**
Poland	150	35,150	6,250			**41,550**
Portugal		28,300				**28,300**
Romania		5,500				**5,500**
Slovak Republic		7,700	800			**8,500**
Slovenia		6,300	600			**6,900**
South Africa	65,100	13,800				**78,900**
Spain		161,875	13,125			**175,000**
Sweden	13,416	19,825	8,713			**41,954**
Switzerland**	8,953	50,355	1,508	1,000		**61,816**
Taiwan		113,646	8,554			**122,200**
Thailand		6,800				**6,800**
Tunisia		34,526	474			**35,000**
Turkey		700,000				**700,000**
United Kingdom		14,000	14,000			**28,000**
United States	1,335,656	119,380	5,110	0	557	**1,460,703**
Uruguay		1,429				**1,429**
Zimbabwe		86				**86**
TOTAL	**2,188,301**	**6,273,241**	**17,383,675**	**41,877**	**17,995**	**25,905,090**

* If no data is given: no reliable database for this collector type available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 15: Collector area installed in 2006 [m²/a]

Country	Water Collectors			Air Collectors		TOTAL [m²]
	Unglazed*	Glazed*	evacuated tube*	Unglazed*	Glazed*	
Albania		9,290	88			**9,378**
Australia	576,000	203,000	3,000			**782,000**
IparAustria	8,662	277,620	3,399			**289,681**
Barbados		2,731				**2,731**
Belgium	8,828	37,000	5,000			**50,828**
Brazil	97,442	475,394	350			**573,186**
Bulgaria		2,500				**2,500**
Canada	39,879	1,462	2,385	17,056	128	**60,910**
Chile		7,957				**7,957**
China		1,150,000	21,850,000			**23,000,000**
Cyprus		15,000	1,000			**16,000**
Czech Republic	6,000	18,900	6,100			**31,000**
Denmark	600	23,000	400	3,400	3,500	**30,900**
Estonia		350				**350**
Finland		2,100	622			**2,722**
France	5,300	305,000	12,700			**323,000**
Germany	30,000	840,000	100,000		5,000	**975,000**
Greece		279,000	4,000			**283,000**
Hungary		6,000	2,000			**8,000**
India		424,150			7,000	**431,150**
Ireland		14,872	4,799			**19,671**
Israel	700	301,000				**301,700**
rarsid6095729 Italy	3,650	210,000	35,000			**248,650**
Japan		166,223	4,051		12,509	**182,783**
Jordan		7,666	3,600			**11,266**
Korea		38,700				**38,700**
Lativa		1,500				**1,500**
Lithuania		700				**700**
Luxembourg		3,000				**3,000**
Macedonia		1,952	200			**2,152**
Malta		5,500				**5,500**
Mexico	46,281	107,989				**154,270**
Namibia		2,810	190			**3,001**
Netherlands	27,722	19,920				**47,642**
New Zealand	600	11,800	5,150			**17,550**
Norway	200	720	50			**970**
Poland		47,032	21,115			**68,147**
Portugal	618	44,483	5,696			**50,797**
Romania		6,500				**6,500**
Slovak Republic		15,554	9,911			**25,465**
Slovenia		6,515	1,150			**7,665**
South Africa	67,300	14,000	0			**81,300**
Spain	3,000	251,000	11,000			**265,000**
Sweden	20,435	15,554	9,911			**45,900**
Switzerland**	10,320	63,022	2,554	2,000		**77,896**
Taiwan		125,000	9,900			**134,900**
Thailand		8,000				**8,000**
Tunisia		39,000	1,000			**40,000**
Turkey		700,000				**700,000**
United Kingdom		27,000	27,000			**54,000**
United States	1,113,434	142,597	22,574	0	1,393	**1,279,998**
Uruguay		2,857				**2,857**
Zimbabwe		171				**171**
TOTAL	**2,066,971**	**6,483,092**	**22,165,895**	**22,456**	**29,530**	**30,767,944**

* If no data is given: no reliable database for this collector type available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 16: Collector area installed in 2007 [m²/a]

Country	Water Collectors			Air Collectors		TOTAL [m²]
	Unglazed*	Glazed*	evacuated tube*	Unglazed*	Glazed*	
Albania		49,930	246			**50,176**
Australia	4,070,000	1,660,000	23,000			**5,753,000**
Austria	608,890	2,949,558	42,983			**3,601,431**
Barbados		82,794				**82,794**
Belgium	48,828	133,750	12,368			**194,946**
Brazil	97,442	3,587,499	350			**3,685,291**
Bulgaria		27,600				**27,600**
Canada	665,920	81,755	4,747	129,962	191	**882,575**
Chile	1,470	9,773				**11,243**
China		9,840,547	98,159,453			**108,000,000**
Cyprus		794,749	962			**795,710**
Czech Republic	15,230	97,090	15,490			**127,810**
Denmark	21,370	393,860	3,400	3,400	18,750	**440,780**
Estonia		1,470				**1,470**
Finland	500	15,583	1,302			**17,385**
France	104,500	1,416,500	33,000			**1,554,000**
Germany	750,000	7,784,095	863,982			**9,398,077**
Greece		3,566,200	6,800			**3,573,000**
Hungary	2,800	41,340	2,560			**46,700**
India		2,150,000			17,000	**2,167,000**
Ireland		27,657	7,910			**35,567**
Israel	24,200	3,734,878		422		**3,759,500**
Italy	26,270	873,520	102,860			**1,002,650**
Japan		6,824,569	127,069	434,371	12,509	**7,398,518**
Jordan		840,332	7,200			**847,532**
Korea		1,389,134				**1,389,134**
Latvia		5,350				**5,350**
Lithuania		3,450				**3,450**
Luxembourg		18,900				**18,900**
Macedonia		19,070	200			**19,270**
Malta		29,360				**29,360**
Mexico	467,592	443,880				**911,473**
Namibia		5,979	190			**6,169**
Netherlands	343,527	329,506				**673,033**
New Zealand	6,217	102,914	10,046			**119,177**
Norway	1,600	11,220	150		1,200	**14,170**
Poland	1,300	197,874	36,723	3,000	2,500	**241,397**
Portugal	594	276,038	5,477			**282,109**
Romania		69,600				**69,600**
Slovak Republic		88,304	9,911			**98,215**
Slovenia		115,815	1,150			**116,965**
South Africa	628,610	247,680				**876,290**
Spain	3,000	1,164,164	45,600			**1,212,764**
Sweden	80,000	223,000	29,000			**332,000**
Switzerland**	212,400	433,490	25,420	838,000		**1,509,310**
Taiwan		1,136,919	118,421			**1,255,340**
Thailand		70,000				**70,000**
Tunisia		216,523	1,477			**218,000**
Turkey		10,150,000				**10,150,000**
United Kingdom		277,920	27,000			**304,920**
United States	17,072,278	1,918,800	580,729	93	215,169	**19,787,070**
Uruguay		2,004				**2,004**
Zimbabwe		17,121	24			**17,145**
TOTAL	**25,254,538**	**65,949,061**	**100,307,200**	**1,409,249**	**267,319**	**193,187,367**

* If no data is given: no reliable database for this collector type available

** Unglazed air collectors in Switzerland: this is a very simple site-built system for hay drying

Table 17: Total collector area in operation at the end of 2007 [m²]

7.6 References to reports and persons that have supplied the data

The realization of the solar heat worldwide report 2008 was kindly supported by national representatives of the recorded countries.

Albania	**Edmond M. Hido**	Albania - EU Energy Efficiency Centre
Australia	**Sonja Ott**	Renewable Energy |Sustainability Victoria
Austria	**Werner Weiss and Manuela Eberl**	AEE INTEC
Barbados		Statistical projection AEE INTEC based on previous data
Belgium		ESTIF 2009
Brazil	**Marcelo Mesquita**	Gestor do DASOL - Depto. Nac. Aquecimento Solar da ABRAVA
Bulgaria	**Annie Dobrinova P.**	Bulgarian National Section of ISES & ESTIF 2009
Canada	**Doug McClenahan**	CANMET - Natural Resources Canada
Chile	**Cristian Yanez**	CDT Chile
	Carlos F. C. Faria	Marcasolar
China	**Hu Runqing**	Center for Renewable Energy Development Energy Research Institute, NDRC
Cyprus	**Soteris Kalogirou**	Cyprus University of Technology; Department of Mechanical Engineering and Materials Sciences and Engineering (personal guessing)
Czech Republic		ESTIF 2009
Denmark		ESTIF 2009
Estonia		ESTIF 2009
Finland	**Peter Lund**	Helsinki University of Technology, Espoo
	Olli Laitinen	Motiva Oy
France	**Céline Coulaud**	ADEME - Centre de Sophia Antipolis
Germany	**Gerhard Stryi-Hipp**	Fraunhofer ISE (sources: Marktanreizprogramm MAP, GroSol-Study)
	Harald Drück	ITW- University of Stuttgart (sources: GroSol-Study, dataanalysis from German market incentive programme)
Greece	**Vassiliki Drosou**	CRES - Centre for Renewable Energy Sources
Hungary		ESTIF 2009

India	**Jaideep Malaviya**	Jawaharlal Nehru National Solar Mission
	C. Palaniappan	Planters Energy Network – PEN
	Ministry of Non-Conventional Energy Sources, Goverment of India	Download Market Assessment report: http://mnes.nic.in/pdf/greentech-SWH-MarketAssessment-report.pdf
Ireland	**Amanda Barriscale**	Sustainable Energy Ireland (Grant scheme data; GHS and REHEAT programmes)
Israel	**Asher Vaturi**	ICTAF - Interdisciplinary Center for Technological Analysis and ForecastingTel Aviv University
Italy	**Valeria Verga**	Associazione Italiana Solare Termico (Assolterm market study [2009])
Japan	**YAMASHITA Noriaki**	ISEP - Institute for Sustainable Energy Policies (ISEP, SSDA, METI)
Jordan	**Nidal Abdalla**	National Energy Research Center (NERC)
Korea	**Nam-choon Baek**	Korea Institute of Energy Research (KIER) (source: 2008 statistics of New & Renewable Energy Supply)
Lativa		ESTIF 2009
Lithuania		ESTIF 2009
Luxembourg		ESTIF 2009
Macedonia	**Sanja Popovska-Vasilevska**	Solar Macedonia, Company Information + Ministry of Economy of Republic of Macedonia
Malta		ESTIF 2009
Mexico	**Wilfrido Rivera Gomez-Franco**	Universidad Nacional Autonoma de Mexico - Centro de Investigacion en Energia
Namibia	**Kudakwashe Ndhlukula**	Renewable Energy & Energy Efficiency Institute (REEEI)
Netherlands	**Reinoud Segers**	Statistics Netherlands
New Zealand		statistical projection AEE INTEC based on previous data
Norway	**Fritjof Salvesen**	KanEnergi AS
Poland	**Grzegorz Wiśniewski; Aneta Wiecka**	EC BREC Institute for Renewable Energy Ltd.
Portugal	**João Farinha Mendes**	Unidadede Energia Solar (sources: APISOLAR [Associação Portuguesa da Indústria Solar] and ADENE [Agência para a Energia])
Romania		ESTIF 2009
Slovak Republic		ESTIF 2009

Slovenia	**Tanja Mohorič**	Tanja Mohorič (sources: SSTTP, Slovenian Solar Thermal Technology Platform; University of Ljubljana, Faculty of Mechanical Engineering; Eko fund, Slovenian Environmental Public Fund)
South Africa	**Dieter Holm**	Soltrain, South Africa - country market report
Spain	**Pascual Polo**	ASIT, Asociación Solar de la Industria Térmica
	Esther Rojas	CIEMAT
Sweden	**Jan-Olof Dalenbäck**	Jan-Olof Dalenbäck, Svensk solenergi & CHALMERS University of Technology
Switzerland	**Urs Wolfer**	Bundesamt für Energie BFE (source: Markterhebung Sonnenergie 2008 SWISSOLAR, Urs Wolfer)
Taiwan	**K.M. Chung**	National Cheng Kung University [NCKU research & development fundation]
Thailand		statistical projection AEE INTEC
Tunisia	**NJEIMI Moncef**	PROSOL - ANME
Turkey	**A. Kutay ULKE**	A. Kutay ULKE [EZINC Metal San. Tic. A.S.]
United Kingdom		ESTIF 2009
United States	**Les Nelson**	Solar Energy Industries Association
		Energy Information Administration (EIA) [http://www.eia.doe.gov/cneaf/solar.renewables/page/solarreport/solar.html]
Uruguay	**Carlos F. C. Faria**	Cabrera&Associados/ Mesa Solar
Zimbabwe	**Anton Schwarzlmüller**	DSH, Soltrain, Zimbabwe - country market report

7.6.1 Additional literature used

The following reports and statistics were used in this report.

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- Market Assessment report - Ministry for New and Renewable Energy, Government of India, homepage: http://mnes.nic.in/; download: http://mnes.nic.in/pdf/greentech-SWH-MarketAssessment-report.pdf
- REN 21: Renewables 2010 Global Status Report, 2010

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