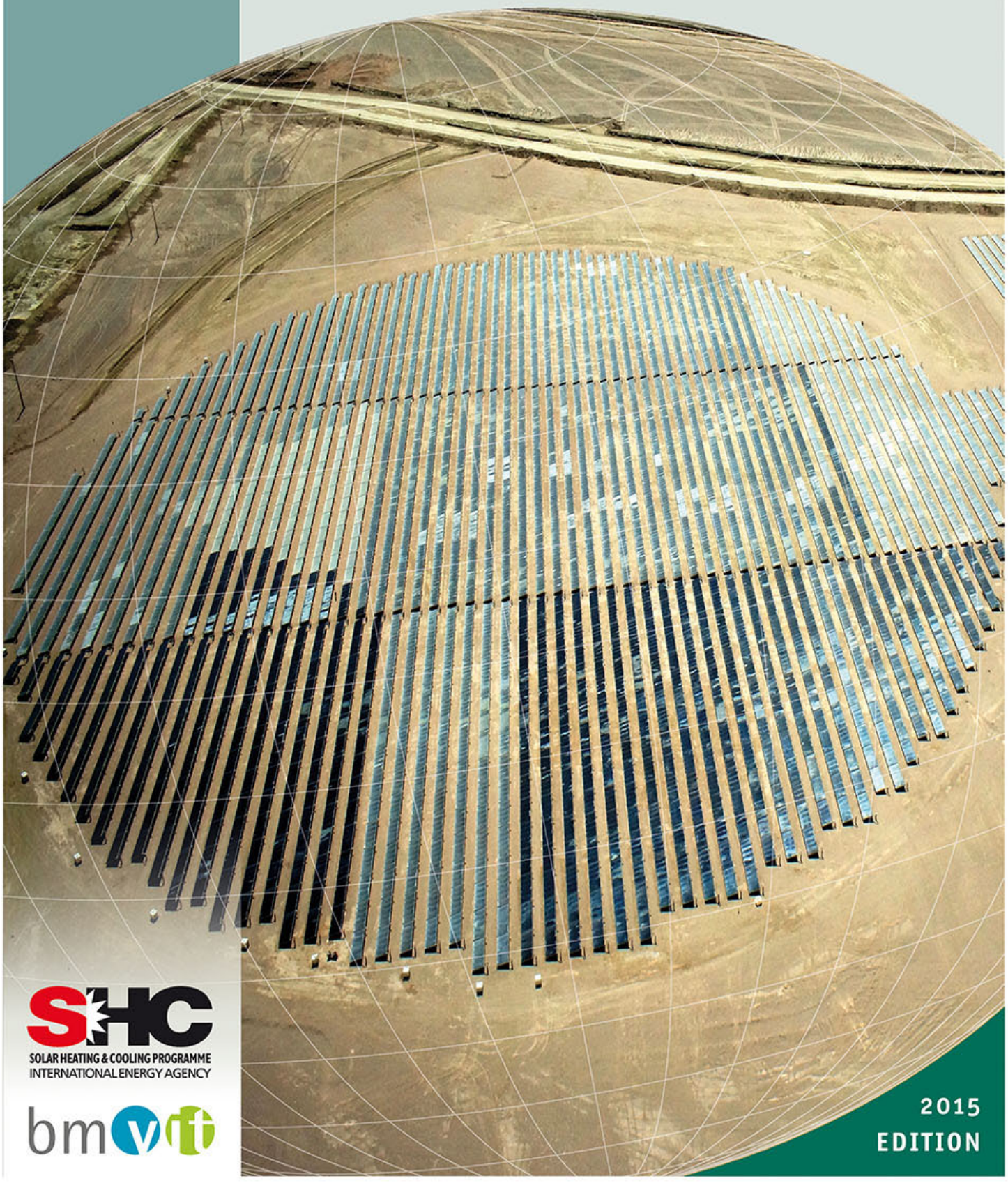
FRANZ MAUTHNER | WERNER WEISS | MONIKA SPÖRK-DÜR

SOLAR HEAT WORLDWIDE

Markets and Contribution to the Energy Supply 2013



SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

bmvit

2015
EDITION

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Markets and Contribution to the Energy Supply 2013

EDITION 2015

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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 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 collectors (FPC) and evacuated tube collectors (ETC) with water as the energy carrier as well as glazed and unglazed air collectors.

The data were collected from a survey of the national delegates of the SHC Programme's Executive Committee and other national experts active in the field of solar thermal energy. As some of the 60 countries included in this report have very detailed statistics and others have only 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 60 countries included in this report represent 4.5 billion people, or about 63% of the world's population. The installed capacity in these countries is estimated to represent 95% of the solar thermal market worldwide.

Figure 1: From countries shown in yellow detailed market data are available.
The market data from all other countries are estimated.

2 Summary

This report comprises solar thermal market data from 60 countries covering an estimated 95% of the worldwide market. The remaining 5% of the market were extrapolated and are labeled as *"all other countries"* in the following sections.

Total installed capacity in operation worldwide by the end of 2013

By the end of 2013, an installed capacity of 374.7 GW_{th}, corresponding to a total of 535 million square meters[1] of collector area was in operation worldwide.

The vast majority of the total capacity in operation was installed in China (262.3 GW_{th}) and Europe (44.1 GW_{th}), which together accounted for 82% of the total capacity installed. The remaining installed capacity was shared between the United States and Canada (17.7 GW_{th}), Asia excluding China (10.0 GW_{th}), Latin America (8.7 GW_{th}), the MENA[2] countries Israel, Jordan, Lebanon, Morocco, the Palestinian Territories and Tunisia (6.1 GW_{th}), Australia and New Zealand (5.9 GW_{th}), and Sub-Sahara African countries Mauritius, Mozambique, Namibia, South Africa and Zimbabwe (1.2 GW_{th}). The market volume of *"all other countries"* is estimated to amount for 5% of the total installations (18.7 GW_{th}).

The breakdown of the cumulated capacity in operation in 2013 by collector type is 22.4% glazed flat-plate collectors, 70.5% evacuated tube collectors, 6.7% unglazed water collectors, and 0.4% glazed and unglazed air collectors.

The leading countries in cumulated unglazed and glazed water collector capacity in operation in 2013 per 1,000 inhabitants were Austria (430 kW_{th}/1,000 inhabitants), Cyprus (425 kW_{th}/1,000 inhabitants), Israel (377 kW_{th}/1,000 inhabitants), Barbados (319 kW_{th}/1,000 inhabitants), Greece (271 kW_{th}/1,000 inhabitants), the Palestinian Territories (257 kW_{th}/1,000 inhabitants), Australia (252 kW_{th}/1,000 inhabitants), China (194 kW_{th}/1,000 inhabitants), Germany (151 kW_{th}/1,000 inhabitants) and Turkey (136 kW_{th}/1,000 inhabitants).

Newly installed capacity worldwide in 2013

In the year 2013, a total capacity of 55.0 GW_{th}, corresponding to 78.6 million square meters of solar collectors, was installed worldwide. This means an increase in new collector installations of 1.8% compared to the year 2012.

The main markets were in China (44.5 GW_{th}) and Europe (3.6 GW_{th}), which together accounted for 87% of the overall new collector installations in 2013. The rest of the market was shared between Latin America (1.2 GW_{th}), Asia excluding China (1.0 GW_{th}), the United States and Canada (0.8 GW_{th}), Australia (0.6 GW_{th}), the MENA region represented by Israel, Jordan, Lebanon, Morocco, the Palestinian Territories and Tunisia (0.5 GW_{th}) and the Sub-Sahara African countries Mozambique, South Africa and Zimbabwe (0.1 GW_{th}).). The market volume of "all other countries" is estimated to amount for 5% of the new installations (2.8 GW_{th}).

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1 To compare the installed capacity of solar thermal collectors with other energy sources, solar thermal experts 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.

2 Middle East and North Africa

The breakdown of the new installed capacity in 2013 by collector type is 17.4% glazed flat-plate collectors, 79.4% evacuated tube collectors, 3.1% unglazed water collectors and 0.1% glazed and unglazed air collectors.

The leading countries in new installed unglazed and glazed water collector capacity in 2013 per 1,000 inhabitants were Israel (38 kW_{th}/1,000 inhabitants), China (33 kW_{th}/1,000 inhabitants); Australia (26 kW_{th}/1,000 inhabitants); the Palestinian Territories (19 kW_{th}/1,000 inhabitants); Turkey (17 kW_{th}/1,000 inhabitants); Austria (15 kW_{th}/1,000 inhabitants); Greece (15 kW_{th}/1,000 inhabitants); Denmark (13 kW_{th}/1,000 inhabitants); Switzerland (12 kW_{th}/1,000 inhabitants) and Cyprus (11 kW_{th}/1,000 inhabitants).

Contribution to the energy supply and CO_2 reduction

The annual collector yield of all water-based solar thermal systems in operation by the end of 2013 in the 60 recorded countries was 314 TWh (= 1,129 PJ). This corresponds to an energy savings equivalent of 33.7 million tons of oil and 109 million tons of CO_2. The calculated number of different types of solar thermal systems in operation was around 111 million.

In 2013, 94% of the energy provided by solar thermal systems worldwide was used for heating domestic hot water, mainly by small-scale systems in single family houses (84%) and larger applications attached to multi-family houses, hotels, schools, etc. (10%). Swimming pool heating held a share of 4% in the contribution to the energy supply and CO_2 reduction and the remaining 2% was met by solar combi-systems.

Globally, in 2013 solar thermal contributed about 1.2% to the overall domestic hot water and space heating demand in buildings[3].

Distribution of systems by system type and application

The thermal use of the sun's energy varies greatly from region to region across the globe. It can be roughly distinguished by the type of solar thermal collector used (unglazed water collectors, evacuated tube collectors, flat plate collectors, glazed and unglazed air collectors, concentrating collectors), the type of system operation (pumped solar thermal systems, thermosiphon systems), and the main type of application (swimming pool heating, domestic hot water preparation, space heating, heating of industrial processes, solar district heating or solar thermal cooling).

For unglazed and glazed water collectors, the evacuated tube collector dominated with a 71% share of the cumulated capacity in operation and a 79% share of the new installed capacity. In China, vacuum tube collectors played an important role, and since this was by far the largest market, the worldwide figures tend towards a higher share of this type of solar thermal collector.

Unglazed water collectors accounted for 7% of the cumulated water collectors installed worldwide and the share tended to decrease. In 2013 the share of unglazed water collectors was 3% of the new installed capacity.

Worldwide, around 77% of all solar thermal systems installed are thermosiphon systems and 23% are pumped solar heating systems. Similar to the distribution by type of solar thermal collector in total numbers, the Chinese market influenced the overall figures most, and in 2013 90% of the new installed systems were estimated to be thermosiphon systems while pumped systems only accounted for 10%.

3 International Energy Agency-Energy Technology Systems Analysis (IEA-ETSAP) and International Renewable Energy Agency (IRENA), Solar Heating and Cooling for Residential Applications, Technology Brief R12 (Bonn: January 2015), p. 1, http://www.irena.org/DocumentDownloads/Publications/IRENA_ETSAP_Tech_Brief_R12_Solar_Thermal_Residential_2015.pdf.

In general, thermosiphon systems are more common in warm climates such as in Africa, South America, southern Europe and the MENA region. In these regions thermosiphon systems are more often equipped with flat plate collectors, while in China, the typical thermosiphon system for domestic hot water preparation is equipped with evacuated tubes.

The calculated number of water-based solar thermal systems in operation was approximately 111 million by the end of 2013. The breakdown is 6% used for swimming pool heating, 80% used for domestic hot water preparation in single family houses, and 9% attached to larger domestic hot water consumers, such as multi-family houses, hotels, hospitals, schools, etc. Around 3% of the installed capacity worldwide supplied heat for both domestic hot water and space heating (solar combi-systems). The remaining systems accounted for about 1% or almost 5 million square meters of solar thermal collectors and delivered heat to district heating networks, industrial processes or thermally driven solar cooling applications.

Compared to the cumulated installed capacity, the share of swimming pool heating was much less for new installations (6% of total capacity and only 3% of newly installed capacity). To a lesser extent, this is also true for domestic hot water systems in single-family houses (80% of total capacity and 77% of newly installed capacity). However, in 2013 this is still the most common application for solar thermal systems worldwide. The share of large-scale domestic hot water applications tended to increase (9% of total capacity and 17% of newly installed capacity) while the share of solar combi-systems remained at a low level of 3% for both cumulated installations in operation and new installations in 2013.

Development of global solar thermal capacity in operation and energy yields 2000–2014

Global solar thermal capacity of unglazed and glazed water collectors in operation grew from 62 GW_{th} (89 million square meters) in 2000 to 406 GW_{th} (580 million square meters) in 2014. The corresponding annual solar thermal energy yields amounted to 52 TWh in 2000 and to 341 TWh in 2014 (**Figure 2**).

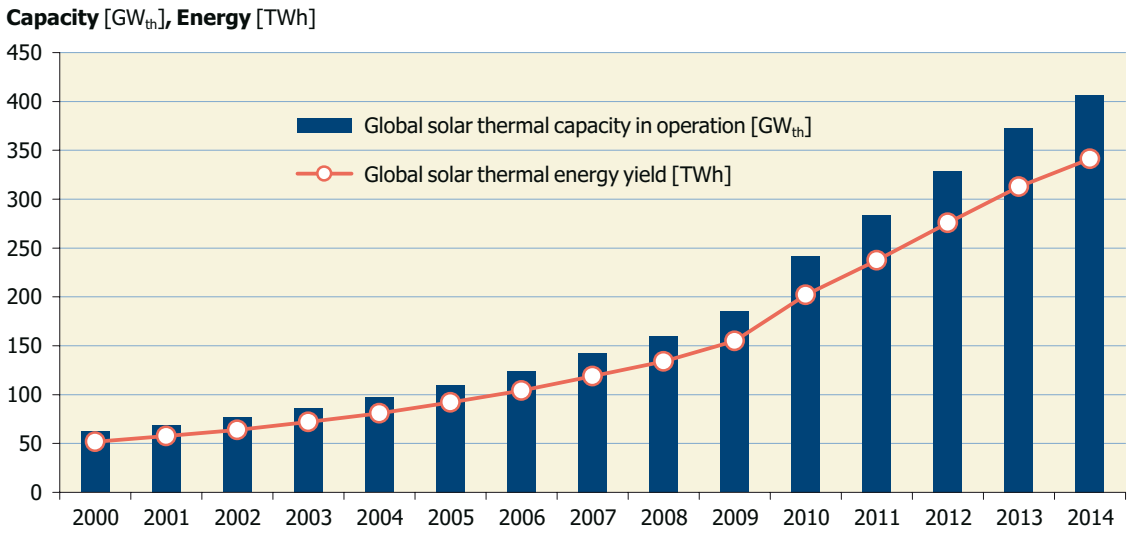


Figure 2: Global solar thermal capacity in operation and annual energy yields 2000–2014

2.1 Preview 2014

The estimated total capacity of solar thermal collectors in operation worldwide by the end of 2014 is 406 GW_{th}, or 580 million square meters of collector area. This corresponds to an annual collector yield of 341 TWh, which is equivalent to savings of 36.7 million tons of oil and 118.6 million tons of CO_2.[4]

The preview for 2014 is based on latest market data from Austria, Brazil, China, Germany and India, which represented more than 82% of the cumulated installed capacity in operation in the year 2013. The other countries were estimated according to their trend over the past two years.

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 (**Figure 3**). Considering installed capacity, solar thermal is leading.

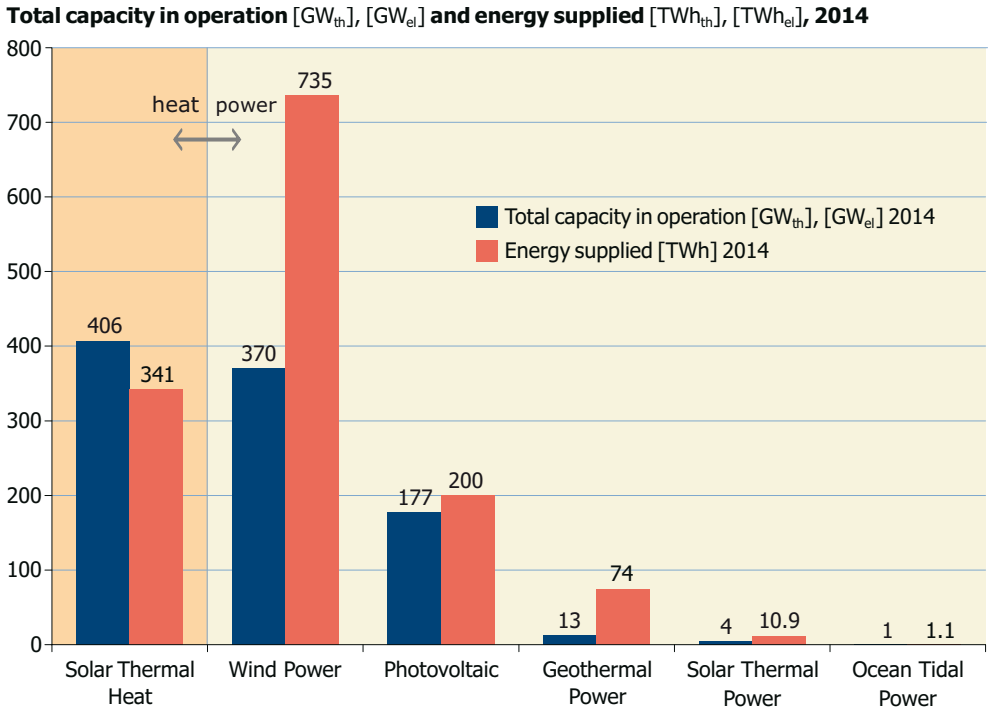


Figure 3: Global capacity in operation [GW_{el}], [GW_{th}] 2014 and annual energy yields [TWh_{el}], [TWh_{th}] *(Sources: AEE INTEC, Global Wind Energy Council (GWEC), European PV Industry Association (EPIA), REN21 - Global Status Reports 2014 and 2015)*

4 Note that, in 2014, the Chinese Solar Thermal Industry Federation (CSTIF) settled on a new methodology for calculating cumulative capacity in operation. Because China is such a large market, this change has a significant effect on the global total. In this edition, the report data have been adjusted accordingly: China's total for 2011 was adjusted upwards to 190 GW_{th} (from 152 GW_{th} as reported in previous editions of this report). China's total for 2012 amounted to 226 GW_{th} (adjusted upwards from 180 GW_{th}) and China's total for 2013 amounted to 262 GW_{th} (adjusted upwards from 217 GW_{th}).
Consequently the world totals in operation were revised as well: World 2011 was adjusted upwards to 284 GW_{th} (from 244 GW_{th}, excluding air collectors). World 2012 was adjusted upwards to 329 GW_{th} (from 281 GW_{th}, excluding air collectors) and World 2013 was adjusted upwards to 373 GW_{th} (from 325 GW_{th}, excluding air collectors).

The development of global installed capacity of solar thermal heat, wind and photovoltaic between 2010 and 2014 is shown in **Figure 4**. It can be highlighted that all mentioned renewable technologies show positive growth rates in terms of cumulated installed capacities, but as a general trend the growth rates tend to flatten out.

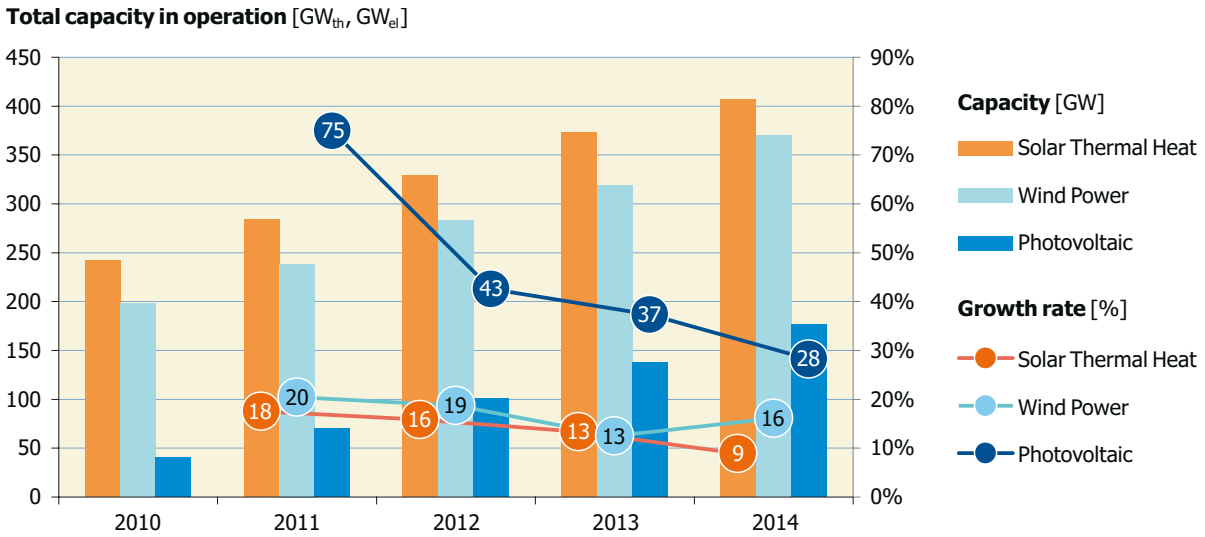


Figure 4: Global solar thermal heat, wind power and photovoltaic capacity in operation and market growth rates between 2010 and 2014

(Sources: AEE INTEC, Global Wind Energy Council (GWEC), European PV Industry Association (EPIA), REN21)

Employment

Based on data collected from the detailed country reports, the number of jobs in the fields of production, installation and maintenance of solar thermal systems is estimated to be 460,000 worldwide in 2014.

3 Total capacity in operation by end of 2013

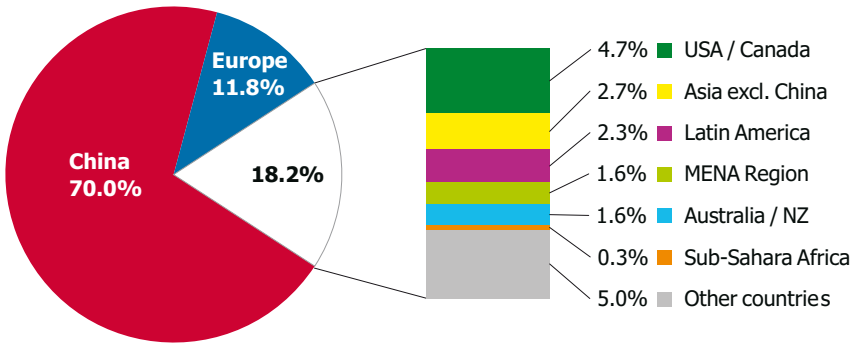
This report aims to give the actual collector area in operation and not the cumulated collector area that has ever been installed in a country. To determine the collector area (and respective capacity) in operation, either official country reports on the lifetime were used or, if such reports were not available, a 25-year lifetime for a system was calculated. The collector area in operation was then calculated using a linear equation. For China, the methodology of the Chinese Solar Thermal Industry Federation (CSTIF) was used. According to the CSTIF approach the operation lifetime is considered to be less than 10 years.

The analysis further aims to distinguish between different types of solar thermal collectors, such as unglazed water collectors, glazed water collectors including flat plate collectors (FPC) and evacuated tube collectors (ETC) as well as unglazed and glazed air collectors.

3.1 General market overview of the total installed capacity in operation

By the end of 2013, an installed capacity of 374.7 GW_{th} corresponding to a total of 535.2 million square meters of collector area was in operation worldwide.

The vast majority of the total capacity in operation was installed in China (262.3 GW_{th}) and Europe (44.1 GW_{th}), which together accounted for 82% of the total installed capacity. The remaining installed capacity was shared between the United States and Canada (17.7 GW_{th}), Asia excluding China (10.0 GW_{th}), Latin America (8.7 GW_{th}), the MENA countries Israel, Jordan, Lebanon, Morocco, the Palestinian Territories and Tunisia (6.1 GW_{th}), Australia and New Zealand (5.9 GW_{th}), and Sub-Sahara African countries Mauritius, Mozambique, Namibia, South Africa and Zimbabwe (1.2 GW_{th}). The market volume of *"all other countries"* is estimated to amount for 5% of the total installations (18.7 GW_{th}).



Sub-Sahara Africa:	Mauritius, Mozambique, Namibia, South Africa, Zimbabwe
Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Latin America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	EU 28, Albania, Macedonia, Norway, Russia, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Figure 5: Share of the total installed capacity in operation (glazed and unglazed water and air collectors) by economic region at the end of 2013

Country	Water Collectors [MW_{th}]			Air Collectors [MW_{th}]		TOTAL [MW_{th}]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		98.6	0.7			99
Australia	3,346.0	2,201.5	68.6	210.0	5.5	5,832
Austria	372.2	3,109.4	57.7		2.0	3,541
Barbados*		92.2				92
Belgium	31.5	264.1	45.8			341
Brazil	2,055.4	4,664.1	6.9			6,726
Bulgaria		86.6	1.8			88
Canada	550.1	44.9	27.5	261.2	20.8	905
Chile		97.5				98
China		19,437.3	242,824.7			262,262
Croatia		100.1	1.8			102
Cyprus	1.5	472.6	16.5			491
Czech Republic	352.1	257.7	70.1			680
Denmark	14.4	528.8	6.4	2.3	12.6	564
Estonia		3.5	2.5			6
Finland	8.2	23.1	5.2			37
France (mainland) +	74.0	1,542.0	43.3	3.5	0.8	1,664
Germany	393.5	10,538.5	1,327.9		20.6	12,281
Greece		2,912.1	12.8			2,925
Hungary	10.0	125.4	41.0	1.4	1.2	179
India ++		2,277.1	2,084.7		5.7	4,368
Ireland		130.2	64.2			194
Israel	24.2	2,880.4	0.4	0.4		2,905
Italy	30.6	2,200.9	353.5			2,585
Japan		2,797.6	54.4		358.6	3,211
Jordan****	4.2	649.6	180.9			835
Korea, South		1,233.8				1,234
Latvia		3.0	1.2			4
Lebanon		172.2	220.5			393
Lithuania		2.9	2.9			6
Luxembourg		28.0	4.0			32
Macedonia		28.3	4.7			33
Malta		27.1	6.8			34
Mauritius #		80.6				81
Mexico	598.7	659.7	489.5	0.5	6.1	1,755
Morocco		290.5				291
Mozambique			0.3			0
Namibia***		14.5	0.9			15
Netherlands	296.8	307.1	12.4			616
New Zealand*	4.9	100.1	6.8			112
Norway	1.3	24.0	2.4		2.8	31
Palestinian Territories #		1,134.0	4.9			1,139
Poland		774.5	265.0			1,040
Portugal	1.5	614.3	17.5			633
Romania		60.0	30.0	0.6		91
Russia		11.7	1.0			13
Slovakia		91.0	14.2			105
Slovenia		115.9	14.9			131
South Africa	641.8	303.1	109.7			1,055
Spain	96.6	2,018.7	121.5			2,237
Sweden	91.0	183.4	43.4			318
Switzerland	148.2	760.0	61.2	560.0		1,529
Taiwan	1.0	1,025.7	55.2			1,082
Thailand		95.6				96
Tunisia		445.4	49.1			494
Turkey		9,114.6	1,854.7	1.4		10,971
United Kingdom		395.5	125.2	14.0		535
United States	14,635.1	1,964.7	90.2	72.2	19.5	16,782
Uruguay**		8.8				9
Zimbabwe		14.5	1.6			16
All other countries #	1,252	4,192	13,206	59	24	18,733
TOTAL	25,037	83,831	264,117	1,187	481	374,651

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

* Total capacity in operation refers to the year 2009

** Total capacity in operation refers to the year 2011

*** Total capacity in operation refers to the year 2012

**** Total capacity in operation is based on estimations for new installations in 2013

\# Newly included countries compared to the 2014 edition of this report

\+ The figures for France relate to Metropolitan France (mainland) only. Overseas Departments were not taken into account in this years statistics.

++ The figures for India refer to fiscal year end (April 2013 – March 2014)

Table 1: Total capacity in operation by the end of 2013 [MW_{th}]

Country	Water Collectors [m²]			Air Collectors [m²]		TOTAL [m²]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		140,815	1,070			141,885
Australia	4,780,000	3,145,000	98,000	300,000	7,840	8,330,840
Austria	531,691	4,442,045	82,362		2,918	5,059,016
Barbados*		131,690				291,690
Belgium	45,000	377,330	65,453			487,783
Brazil	2,936,351	6,663,003	9,909			9,609,263
Bulgaria		123,680	2,520			126,200
Canada	785,857	64,210	39,303	373,154	29,724	1,292,248
Chile		139,309				139,309
China		27,767,614	346,892,386			374,660,000
Croatia		143,065	2,500			145,565
Cyprus	2,180	675,200	23,567			700,947
Czech Republic	503,000	368,119	100,150			971,269
Denmark	20,515	755,378	9,197	3,264	18,000	806,354
Estonia		4,930	3,590			8,520
Finland	11,779	33,051	7,372			52,202
France (mainland) +	105,699	2,202,904	61,796	5,053	1,117	2,376,569
Germany	562,176	15,055,000	1,897,000		29,491	17,543,667
Greece		4,160,100	18,250			4,178,350
Hungary	14,300	179,200	58,600	2,000	1,650	255,750
India ++		3,253,010	2,978,190		8,200	6,239,400
Ireland		185,952	91,667			277,619
Israel	34,617	4,114,876	622	550		4,150,665
Italy	43,766	3,144,110	505,020			3,692,896
Japan		3,996,621	77,775		512,219	4,586,615
Jordan****	5,940	927,951	258,379			1,192,270
Korea, South		1,762,570				1,762,570
Latvia		4,350	1,690			6,040
Lebanon		246,000	315,000			561,000
Lithuania		4,100	4,100			8,200
Luxembourg		40,050	5,750			45,800
Macedonia		40,380	6,750			47,130
Malta		38,758	9,690			48,448
Mauritius #		115,113				115,113
Mexico	855,253	942,482	699,342	752	8,773	2,506,602
Morocco		415,000				415,000
Mozambique			416			416
Namibia***		20,699	1,307			22,006
Netherlands	424,052	438,702	17,696			880,450
New Zealand*	7,025	142,975	9,644			159,645
Norway	1,926	34,236	3,414		4,067	43,643
Palestinian Territories #		1,620,000	7,000			1,627,000
Poland		1,106,400	378,600			1,485,000
Portugal	2,128	877,551	24,950			904,629
Romania		85,700	42,850	800		129,350
Russia		16,756	1,457			18,213
Slovakia		129,950	20,250			150,200
Slovenia		165,550	21,250			186,800
South Africa	916,881	432,946	156,784			1,506,611
Spain	137,985	2,883,812	173,542			3,195,339
Sweden	130,000	262,000	62,000			454,000
Switzerland	211,740	1,085,760	87,440	800,000		2,184,940
Taiwan	1,394	1,465,311	78,924			1,545,628
Thailand		136,611				136,611
Tunisia		636,276	70,104			706,380
Turkey		13,020,812	2,649,509	2,070		15,672,391
United Kingdom		565,025	178,848	20,000		763,873
United States	20,907,216	2,806,716	128,832	103,139	27,800	23,973,703
Uruguay**		12,571				12,571
Zimbabwe		20,756	2,222			22,978
All other countries #	1,788,341	5,987,899	18,865,476	84,778	34,305	26,760,799
TOTAL	35,766,811	119,757,981	377,309,514	1,695,560	686,105	535,215,971

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

* Total capacity in operation refers to the year 2009

** Total capacity in operation refers to the year 2011

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**** Total capacity in operation is based on estimations for new installations in 2013

\# Newly included countries compared to the 2014 edition of this report

\+ The figures for France relate to Metropolitan France (mainland) only. Overseas Departments were not taken into account in this years statistics.

++ The figures for India refer to fiscal year end (April 2013 – March 2014)

Table 2: Total installed collector area in operation by the end of 2013 [m²]

The total installed capacity in operation by end of 2013 is divided into flat plate collectors (FPC): 83.9 GW_{th} (119.9 million square meters), evacuated tube collectors (ETC): 264.1 GW_{th} (377.3 million square meters), unglazed water collectors 25.0 GW_{th} (35.7 million square meters), and glazed and unglazed air collectors: 1.7 GW_{th} (2.4 million square meters).

With a share of 70.5%, evacuated tube collectors are the predominant solar thermal collector technology worldwide, followed by flat plate collectors with 22.4% and unglazed water collectors with 6.7%. Air collectors only play a minor role in total numbers (**Figure 6**).

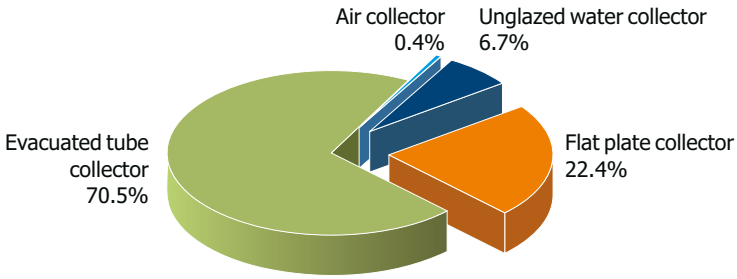


Figure 6: Distribution of the total installed capacity in operation by collector type in 2013 – WORLD

By contrast in Europe, the second largest marketplace for solar thermal collectors to China, flat plate collectors are much more widespread (**Figure 7**).

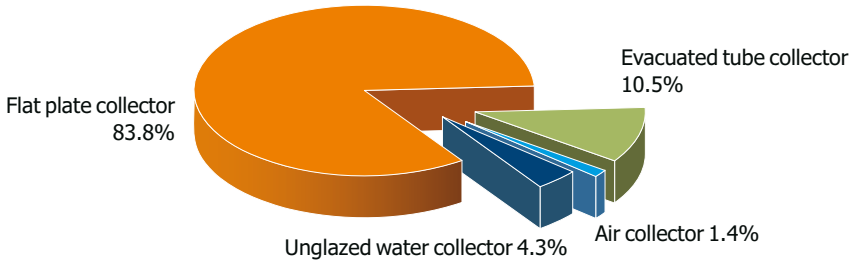


Figure 7: Distribution of the total installed capacity in operation by collector type in 2013 – EUROPE

Figure 8 shows the cumulated installed capacity of glazed and unglazed water collectors in operation for the 10 leading markets in 2013 in total numbers.

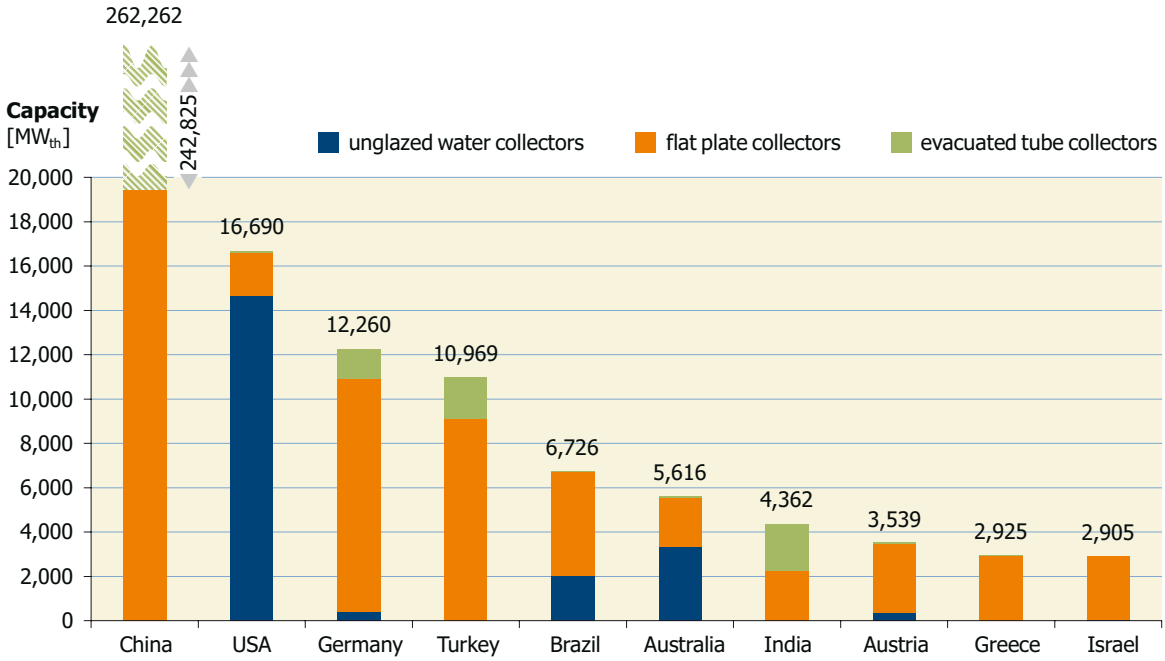


Figure 8: Top 10 countries of cumulated water collector installations (absolute figures in MW_{th})

China, as the world leader in total capacity, is focusing very much on evacuated tube collectors, whereas the United States is holding second position due to its high installation of unglazed water collectors. Only in Australia, and to some extent in Brazil, unglazed water collectors also play an important role. The rest of the "Top 10 countries" are clearly focusing on flat plate collector technology.

The leading countries in cumulated unglazed and glazed water collector capacity in operation in 2013 per 1,000 inhabitants were Austria (430 kW_{th}/1,000 inhabitants), Cyprus (425 kW_{th}/1,000 inhabitants), Israel (377 kW_{th}/1,000 inhabitants), Barbados (319 kW_{th}/1,000 inhabitants), Greece (271 kW_{th}/1,000 inhabitants), the Palestinian Territories (257 kW_{th}/1,000 inhabitants), Australia (252 kW_{th}/1,000 inhabitants), China (194 kW_{th}/1,000 inhabitants), Germany (151 kW_{th}/1,000 inhabitants) and Turkey (136 kW_{th}/1,000 inhabitants).

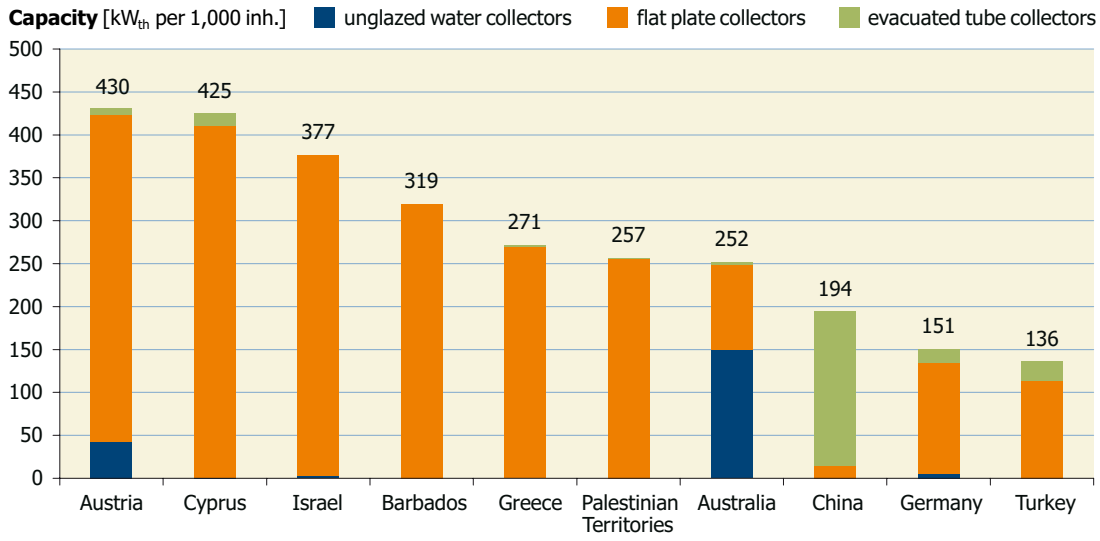


Figure 9: Top 10 countries of cumulated water collector installations (relative figures in kW_{th} per 1,000 inhabitants)

3.2 Total capacity of glazed water collectors in operation

With 262.3 GW_{th}, China was by far the leader in terms of total installed capacity of glazed water collectors in 2013. With >10 GW_{th} of installed capacity, Germany and Turkey were next. Several countries, namely Brazil, India, Austria, Greece, Israel, Japan, Italy, Australia, Spain, the United States, France, South Korea, Mexico, the Palestinian Territories, Taiwan and Poland had more than 1 GW_{th} of water collectors installed by the end of 2013 (**Figure 10**).

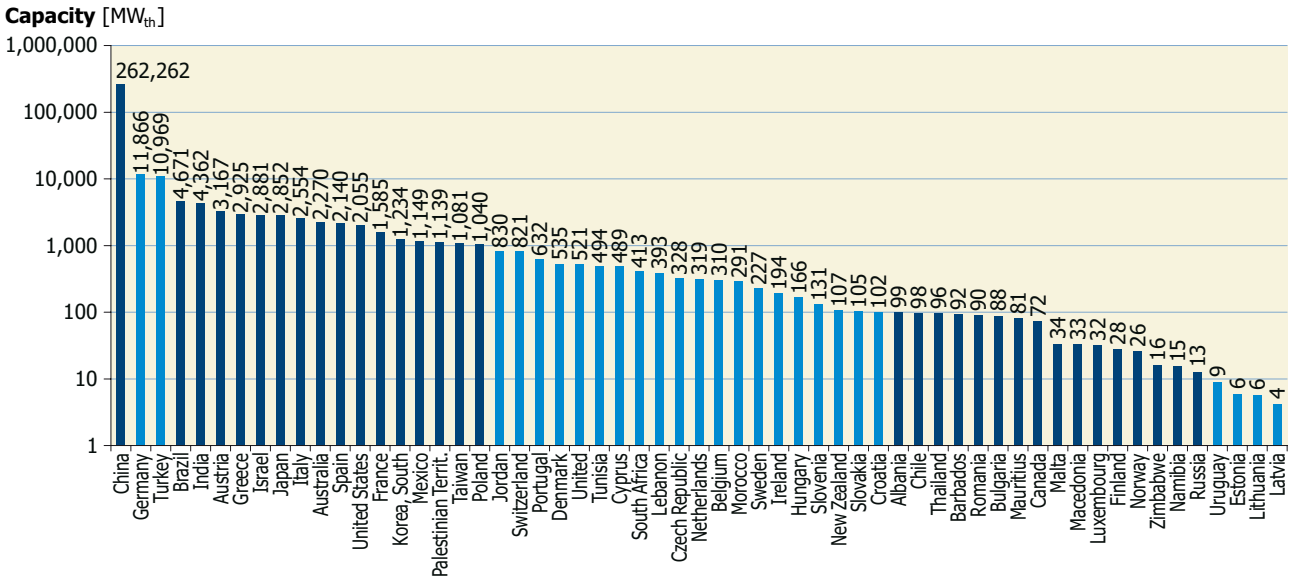


Figure 10: Total capacity of glazed water collectors in operation by the end of 2013

In terms of total installed capacity of glazed water collectors in operation per 1,000 inhabitants, there was a continued dominance by five countries: Cyprus ahead of Austria, Israel, Barbados and Greece. In 2013, China was catching up with the Top 10 countries and exceeded the per capita levels of the large European markets of Germany and Turkey for the first time (**Figure 11**).

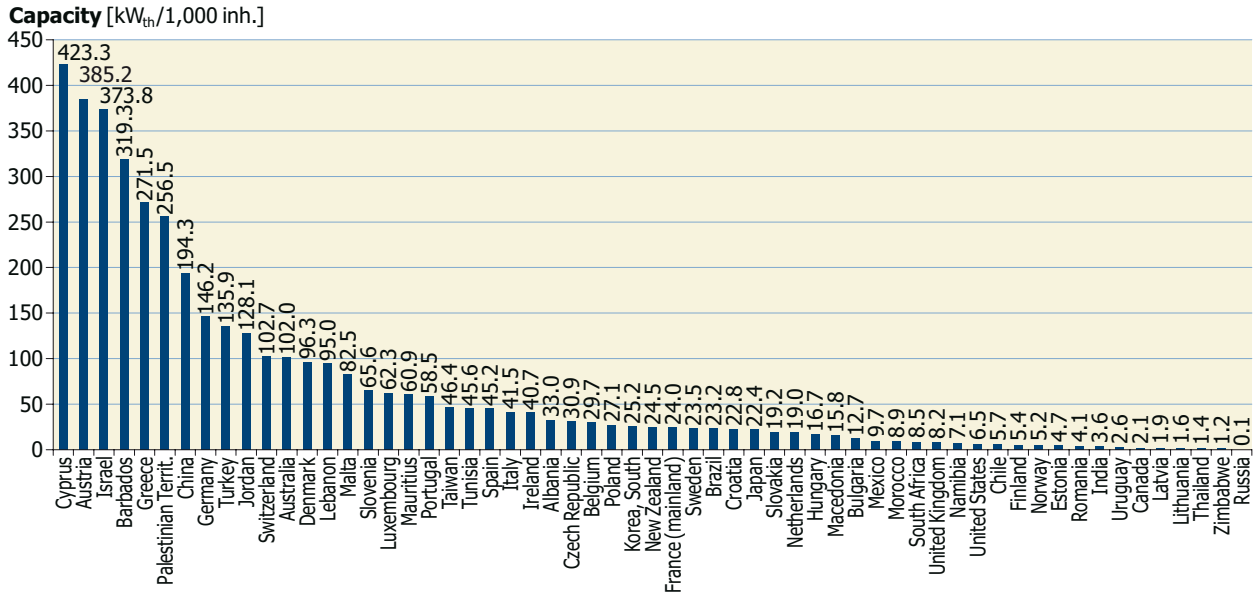


Figure 11: Total capacity of glazed water collectors in operation in kW_{th} per 1,000 inhabitants by the end of 2013

3.3 Total capacity of glazed water collectors in operation by economic region

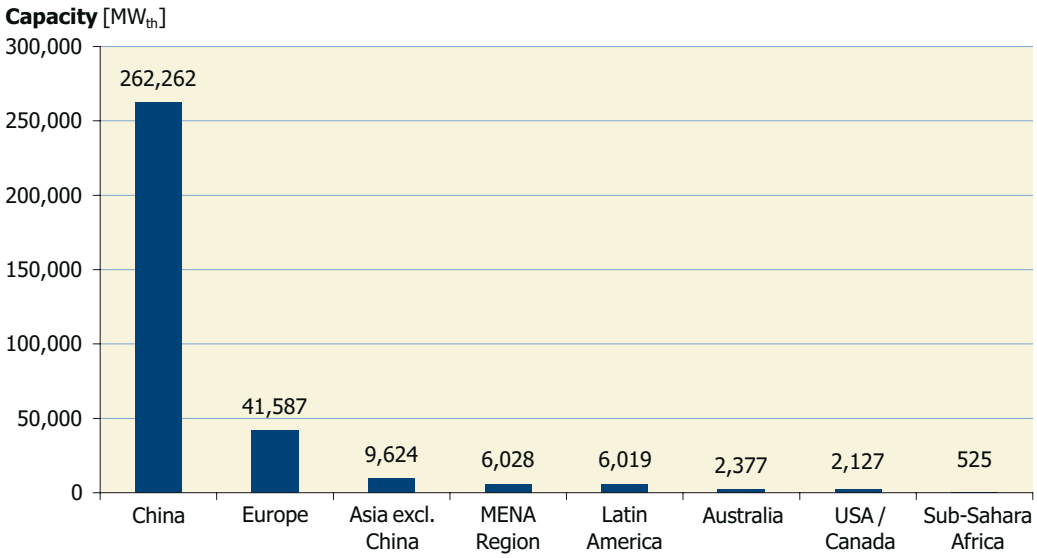
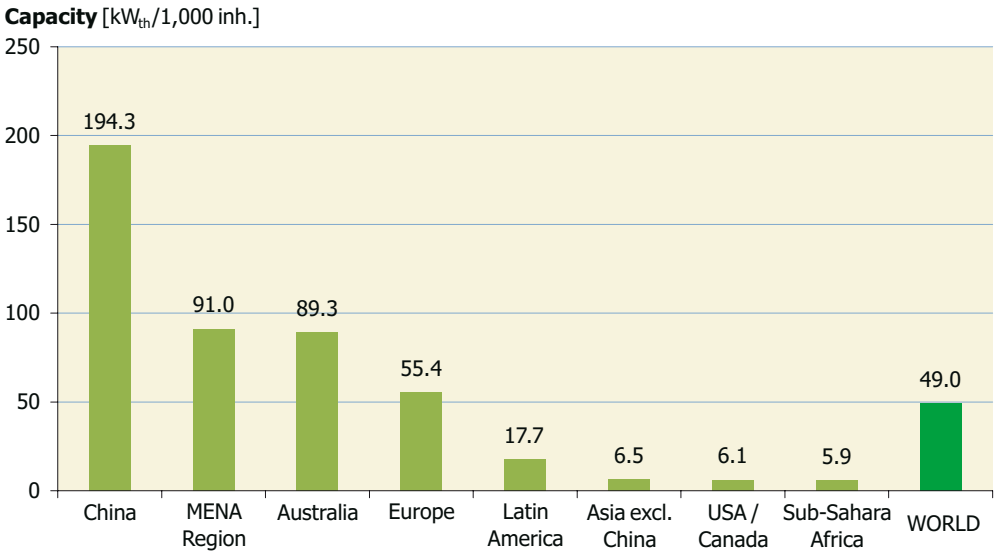


Figure 12: Total capacity of glazed flat plate and evacuated tube collectors in operation by economic region at the end of 2013



Sub-Sahara Africa:	Mauritius, Mozambique, Namibia, South Africa, Zimbabwe
Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Latin America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	EU 28, Albania, Macedonia, Norway, Russia, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Figure 13: Total capacity of glazed flat plate and evacuated tube collectors in operation by economic region and in kW_{th} per 1,000 inhabitants by the end of 2013

3.4 Total capacity of unglazed water collectors in operation

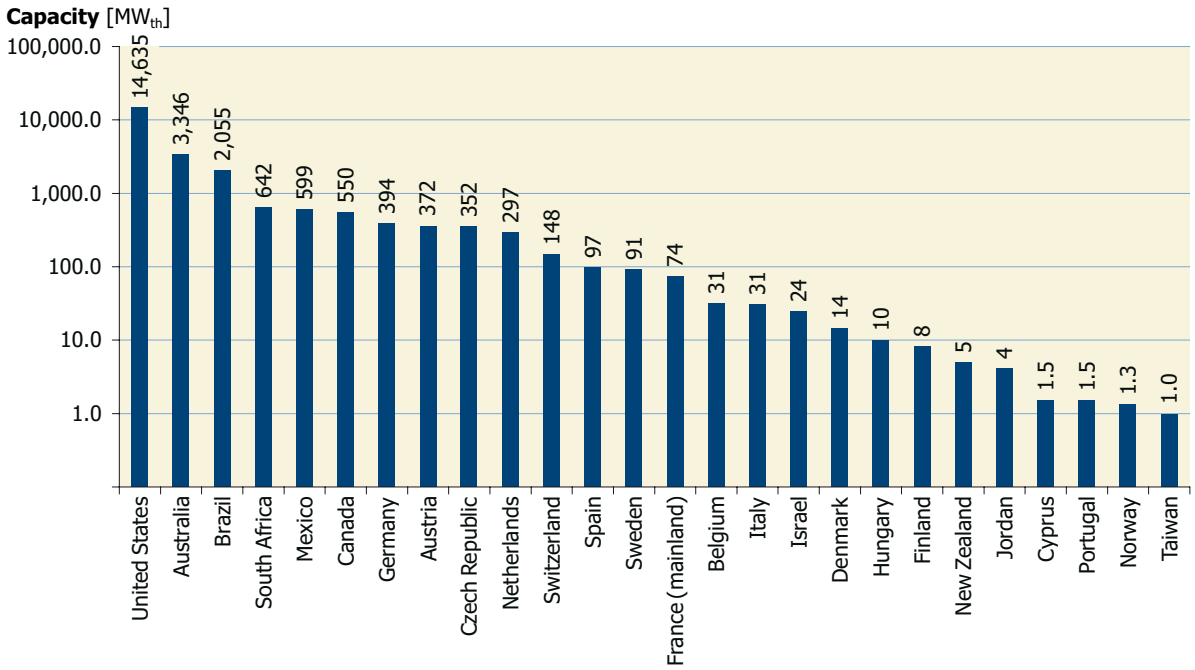


Figure 14: Total capacity of unglazed water collectors in operation by the end of 2013

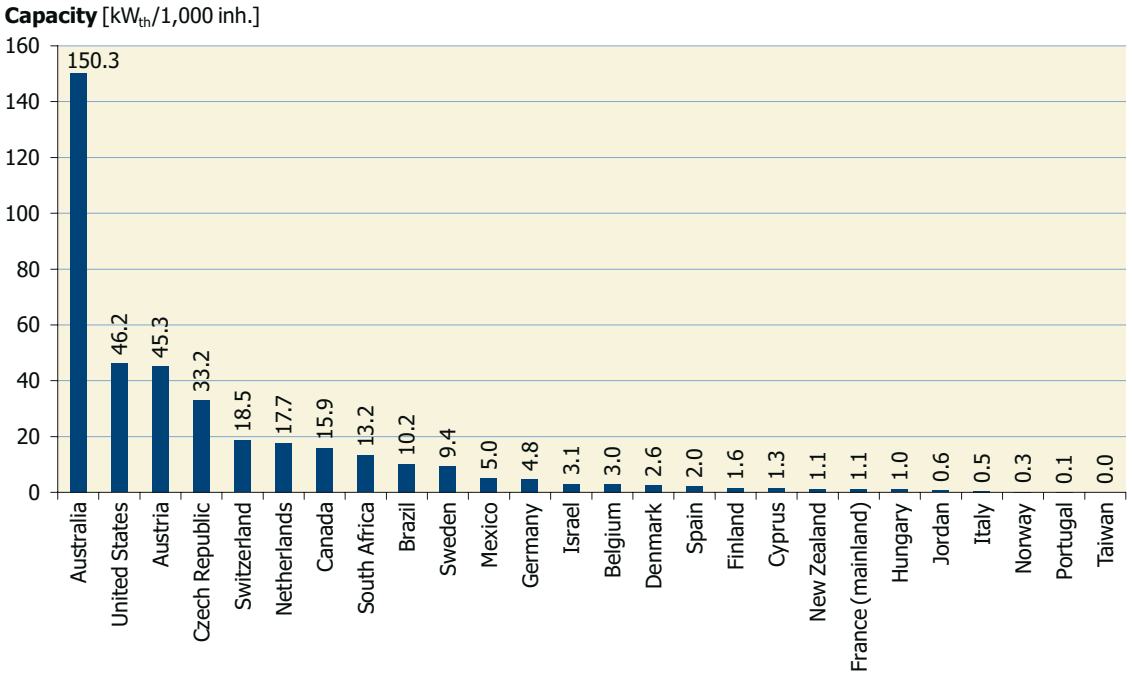


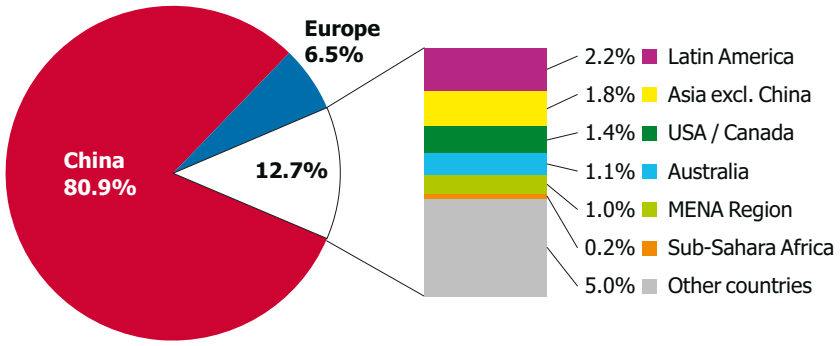
Figure 15: Total capacity of unglazed water collectors in operation in kW_{th} per 1,000 inhabitants by the end of 2013

4 Newly installed capacity in 2013 and market development

4.1 General market overview of newly installed capacity

In the year 2013, a total capacity of 55.0 GW_{th}, corresponding to 78.6 million square meters of solar collectors, was installed worldwide. This means an increase in new collector installations of 1.8% compared to the year 2012 (**Figure 17**). Compared to the previous years, the global market growth rate 2012/2013 tended to flatten out—the market growth in the period 2011/2012 amounted to 6.6% and in the period 2010/2011 to 14.3%.

The main markets were in China (44.5 GW_{th}) and Europe (3.6 GW_{th}), which together accounted for 87% of the overall new collector installations in 2013. The rest of the market was shared between Latin America (1.2 GW_{th}), Asia excluding China (1.0 GW_{th}), the United States and Canada (0.8 GW_{th}), Australia (0.6 GW_{th}), the MENA region represented by Israel, Jordan, Lebanon, Morocco, the Palestinian Territories and Tunisia (0.5 GW_{th}) and the Sub-Sahara African countries Mozambique, South Africa and Zimbabwe (0.1 GW_{th}). The market volume of "all other countries" is estimated to amount for 5% of the new installations (2.8 GW_{th}).

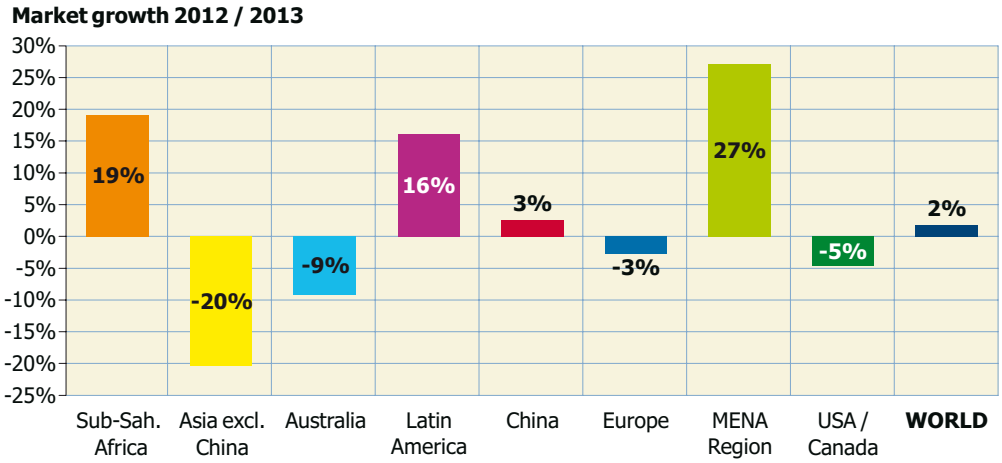


Sub-Sahara Africa:	Mauritius, Mozambique, South Africa, Zimbabwe
Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Latin America:	Brazil, Chile, Mexico
Europe:	EU 28, Albania, Macedonia, Norway, Russia, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Figure 16: Share of newly installed capacity (glazed and unglazed water and air collectors) by economic regions in 2013

From the top 10 markets in 2013 positive market development was reported from China (+2.5%), Turkey (18.2%), Brazil (+19.8%) and Israel (+35.8%). The other major solar thermal markets within the top 10, namely India (–22.9%), the United States (–0.2%), Germany (–11.3%), Australia (–8.8%), Italy (–10.0%) and Poland (–9.2%) suffered market declines.

In terms of economic regions, there was positive market growth in the period 2012/2013 in China, Latin America, the MENA region and Sub-Sahara Africa whereas in Europe, Asia excl. China, the United States and Canada and Australia solar thermal system installations dropped (**Figure 17**).



Sub-Sahara Africa:	South Africa, Zimbabwe
Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Latin America:	Brazil, Chile, Mexico
Europe:	EU 28, Albania, Norway, Switzerland, Turkey
MENA Region:	Israel, Lebanon, Tunisia

Figure 17: Market growth of newly installed capacity (glazed and unglazed water collectors) 2012/2013 by economic region and world-wide

In China, the growth rates between 2000 and 2011 were on average around 23% and since then have been leveling off (+17.6% in 2010/2011, +7.6% in 2011/2012, +2.6% in 2012/2013). For the period 2013/2014 even a market decline of −17.6% was reported from the Chinese Solar thermal industry federation (CSTIF), which means the first negative growth rate in China since official recordings are available (1997).

Almost all of the other Asian countries, excluding China, covered in this report already showed a market decline in the period 2012/2013: India (−22.9%), Japan (−9.0%), South Korea (−24.0%) and Thailand (−28.3%). Only from Taiwan a slight increase of +2.8% was reported.

Major European markets such as Austria, Germany and Italy have been suffering from significant market declines for several years now. In the period 2012/2013 only two countries of the top 10 European countries, namely Turkey (+18.2%) and Spain (+2.3%), reported a positive growth rate. A decrease of −2.8% was reported for all of Europe

In Latin America the large Brazilian market (+19.8%) but also smaller markets such as in Chile (+197%) are responsible for the positive trend in this part of the world lasting the third year in a row (+16.1% in the period 2012/2013).

Both the MENA region and Sub-Sahara Africa recovered well from a market decline in the period 2011/2012 mainly due to positive market growth rates in Israel (largest market in the MENA region) and South Africa (largest market in Sub-Sahara Africa).

The market for water collectors in the United States and Canada significantly decreased in the period 2010/2011 (−15.2%), recovered in 2011/2012 (+1.3%) and dropped again in 2012/2013 (−4.6%)

In Australia, the market for water collectors declined for a fourth year in a row, −5.4% in the period 2009/2010, −10.4% in the period 2010/2011, −4.8% in the period 2011/2012 and[pm4] −9.1% in the period 2012/2013.

Country	Water Collectors [MW_{th}]			Air Collectors [MW_{th}]		TOTAL [MW_{th}]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		20.8	0.2			21
Australia	455.0	115.6	14.7	24.5	0.7	611
Austria	1.0	122.6	2.8		0.7	127
Belgium		34.0	7.4			41
Brazil	435.1	523.1	6.9			965
Bulgaria		3.6	0.4			4
Canada	15.3	2.2	2.6	16.7	3.9	41
Chile		41.5				42
China		4,550.0	39,942.0			44,492
Croatia		12.9	1.8			15
Cyprus	0.0	12.5	0.3			13
Czech Republic	24.5	22.6	8.6			56
Denmark		72.5	0.3			73
Estonia		0.7	0.7			1
Finland		2.1	0.7			3
France (mainland) +		119.9	13.8	0.4		134
Germany		635.6	78.4			714
Greece		158.7	0.3			159
Hungary	0.6	7.4	5.3	0.1	0.1	13
India ++		231.0	539.0		2.8	773
Ireland		11.4	7.3			19
Israel	2.0	294.2	0.1			296
Italy		183.0	24.9			208
Japan		99.8	2.0		6.5	108
Jordan*		38.2	9.6			48
Korea, South		33.9				34
Latvia		1.1	0.4			1
Lebanon		15.4	24.5			40
Lithuania		0.6	1.0			2
Luxembourg		3.5	0.7			4
Macedonia		3.6	0.3			4
Malta		0.8	0.2			1
Mauritius #		6.2				6
Mexico	69.0	60.0	60.0	0.3	0.3	190
Morocco		25.2				25
Mozambique*			0.1			0
Netherlands	19.2	21.1	2.6			43
Norway		2.5	0.6		0.9	4
Palestinian Territories #		80.5	4.9			85
Poland		139.4	52.5			192
Portugal		38.1	2.0			40
Romania		6.3	10.4	0.6		17
Russia		1.1	0.1			1
Slovakia		3.6	0.7			4
Slovenia		5.6	1.4			7
South Africa	35.0	36.3	28.8			100
Spain	2.7	155.8	4.3			163
Sweden	0.2	4.3	1.7			6
Switzerland	7.7	75.6	9.8			93
Taiwan		77.2	7.4			85
Thailand		11.4				11
Tunisia		48.3				48
Turkey		757.6	586.3	0.4		1,344
United Kingdom		22.6	6.0	0.7		29
United States	540.0	156.7	8.1	7.9	5.5	718
Zimbabwe		1.4	1.0			2
All other countries #	84.6	479.5	2,183.5	2.7	1.1	2,751
TOTAL	1,692	9,591	43,669	54	22	55,028

Note: If no data is given: no reliable database for this collector type is available
No data from Barbados, Namibia, New Zealand and Uruguay

* Country market data for new installations in 2013 estimated by AEE INTEC

\# Newly included countries compared to the 2014 edition of this report

\+ The figures for France relate to Metropolitan France (mainland) only. Overseas Departments were not taken into account in this years statistics.

++ The figures for India refer to fiscal year end (April 2013 – March 2014)

Table 3: Newly installed capacity in 2013 [MW_{th}/a]

Country	Water Collectors [m²]			Air Collectors [m²]		TOTAL [m²]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		29,680	284			29,964
Australia	650,000	165,200	21,000	35,000	1,000	872,200
Austria	1,460	175,140	4,040		1,010	181,650
Belgium		48,500	10,500			59,000
Brazil	621,616	747,282	9,909			1,378,807
Bulgaria		5,100	500			5,600
Canada	21,804	3,125	3,650	23,904	5,584	58,067
Chile		59,300				59,300
China		6,500,000	57,060,000			63,560,000
Croatia		18,400	2,500			20,900
Cyprus	33	17,807	472			18,312
Czech Republic	35,000	32,306	12,225			79,531
Denmark		103,600	400			104,000
Estonia		1,000	1,000			2,000
Finland		3,000	1,000			4,000
France (mainland) +		171,273	19,667	500		191,440
Germany		908,000	112,000			1,020,000
Greece		226,700	450			227,150
Hungary	800	10,500	7,500	200	200	19,200
India ++		330,000	770,000		4,000	1,104,000
Ireland		16,330	10,382			26,712
Israel	2,800	420,300	200			423,300
Italy		261,360	35,640			297,000
Japan		142,568	2,847		9,270	154,685
Jordan*		54,531	13,705			68,236
Korea, South		48,473				48,473
Latvia		1,500	500			2,000
Lebanon		22,000	35,000			57,000
Lithuania		800	1,400			2,200
Luxembourg		5,000	1,000			6,000
Macedonia		5,120	453			5,573
Malta		1,083	278			1,361
Mauritius #		8,880				8,880
Mexico	98,550	85,725	85,725	400	400	270,800
Morocco		36,000				36,000
Mozambique*			143			143
Netherlands	27,396	30,079	3,696			61,171
Norway		3,536	846		1,224	5,606
Palestinian Territories #		115,000	7,000			122,000
Poland		199,100	75,000			274,100
Portugal		54,374	2,860			57,234
Romania		9,000	14,850	800		24,650
Russia		1,555	135			1,690
Slovakia		5,200	1,000			6,200
Slovenia		8,000	2,000			10,000
South Africa	50,010	51,902	41,187			143,099
Spain	3,794	222,552	6,169			232,515
Sweden	351	6,124	2,487			8,962
Switzerland	10,952	107,962	14,012			132,926
Taiwan		110,221	10,616			120,838
Thailand		16,251				16,251
Tunisia		69,070				69,070
Turkey		1,082,308	837,539	500		1,920,347
United Kingdom		32,234	8,566	1,000		41,800
United States	771,400	223,800	11,600	11,300	7,800	1,025,900
Zimbabwe		1,995	1,415			3,410
All other countries #	120,840	685,045	3,119,229	3,874	1,605	3,930,592
TOTAL	2,416,806	13,700,891	62,384,577	77,478	32,093	78,611,845

Note: If no data is given: no reliable database for this collector type is available
No data from Barbados, Namibia, New Zealand and Uruguay

* Country market data for new installations in 2013 estimated by AEE INTEC

\# Newly included countries compared to the 2014 edition of this report

\+ The figures for France relate to Metropolitan France (mainland) only. Overseas Departments were not taken into account in this years statistics.

++ The figures for India refer to fiscal year end (April 2013 – March 2014)

Table 4: Newly installed collector area in 2013 [m²/a]

New installations in 2013 are divided into flat plate collectors: 9.6 GW_{th} (13.7 million square meters), evacuated tube collectors: 43.7 GW_{th} (62.4 million square meters), unglazed water collectors: 1.7 GW_{th} (2.4 million square meters,) and glazed and unglazed air collectors: 0.08 GW_{th} (0.11 million square meters).

With a share of 79.4%, evacuated tube collectors are by far the most important solar thermal collector technology worldwide (**Figure 18**). In a global context, this breakdown is mainly driven by the dominance of the Chinese market where around 90% of all newly installed collectors in 2013 were evacuated tube collectors.

By contrast, in Europe the situation is almost the opposite with 74.9% of all solar thermal systems installed in 2013 being flat plate collectors (**Figure 19**).

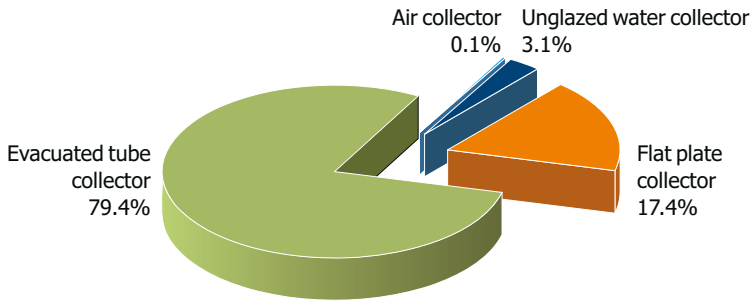


Figure 18: Distribution of the newly installed capacity by collector type in 2013 – WORLD

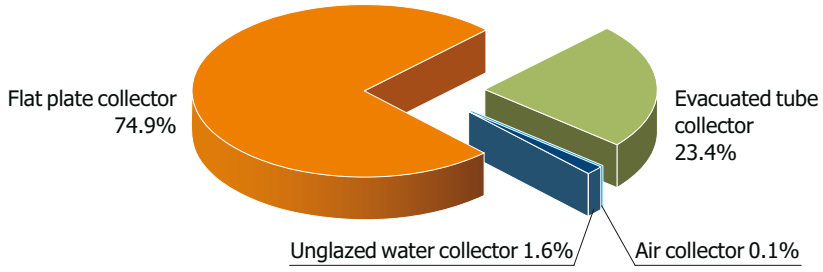


Figure 19: Distribution of the newly installed capacity by collector type in 2013 – EUROPE
Europe: EU 28, Albania, Macedonia, Norway, Russia, Switzerland, Turkey

Figure 20 shows the newly installed capacity of glazed and unglazed water collectors for the 10 leading markets in 2013 in total numbers. Compared to the newly installed capacity in 2012, China remained the market leader in absolute terms followed by Turkey.

India faced a significant market decline in 2013 and hence fell behind Brazil within the top 10 ranking. Despite a market decline in the period 2012/2013 Germany remained fifth followed by the United States and Australia.

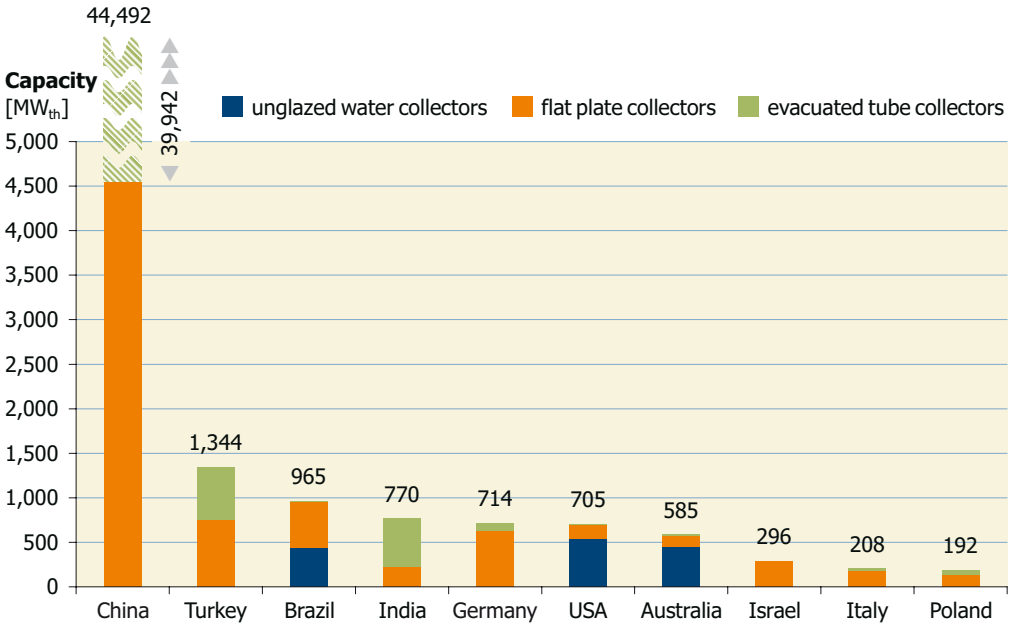


Figure 20: Top 10 markets for glazed and unglazed water collectors in 2013 (absolute figures in MW_{th})

In terms of newly installed solar thermal capacity per 1,000 inhabitants in 2013 Israel took over the lead again, ahead of China and Australia. Palestinian Territories (West Bank and Gaza Strip) were covered the first time in this market report showing a high per capita market penetration, even ahead of the mature solar thermal markets in Turkey, Austria and Greece.

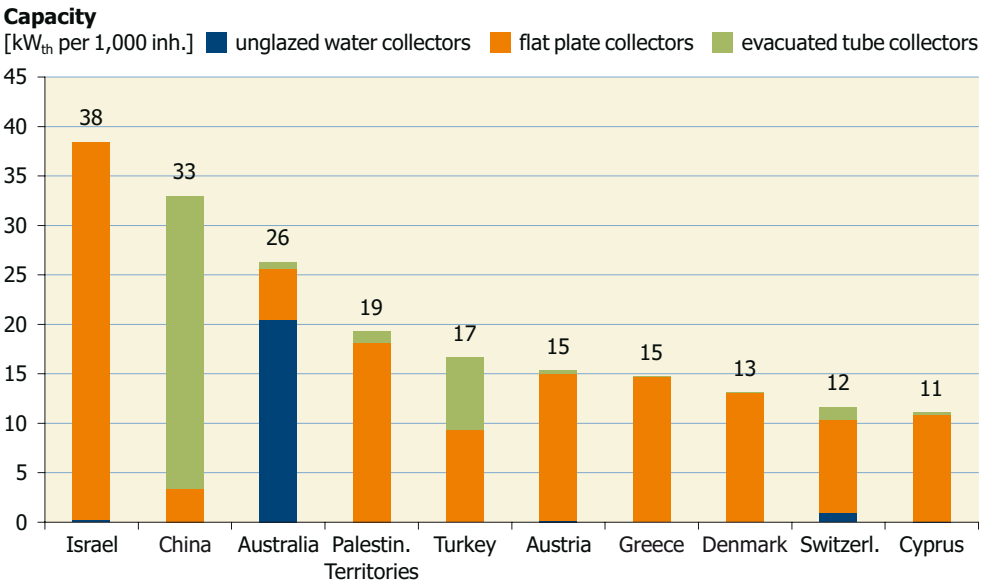


Figure 21: Top 10 markets for glazed and unglazed water collectors in 2013 (relative figures in kW_{th} per 1,000 inhabitants)

4.2 Newly installed capacity of glazed water collectors

In 2013 glazed water collectors accounted for 96.8% of the total newly installed capacity and with a market share of 83.5% China is the most influencing market in a global context (**Figure 22**).

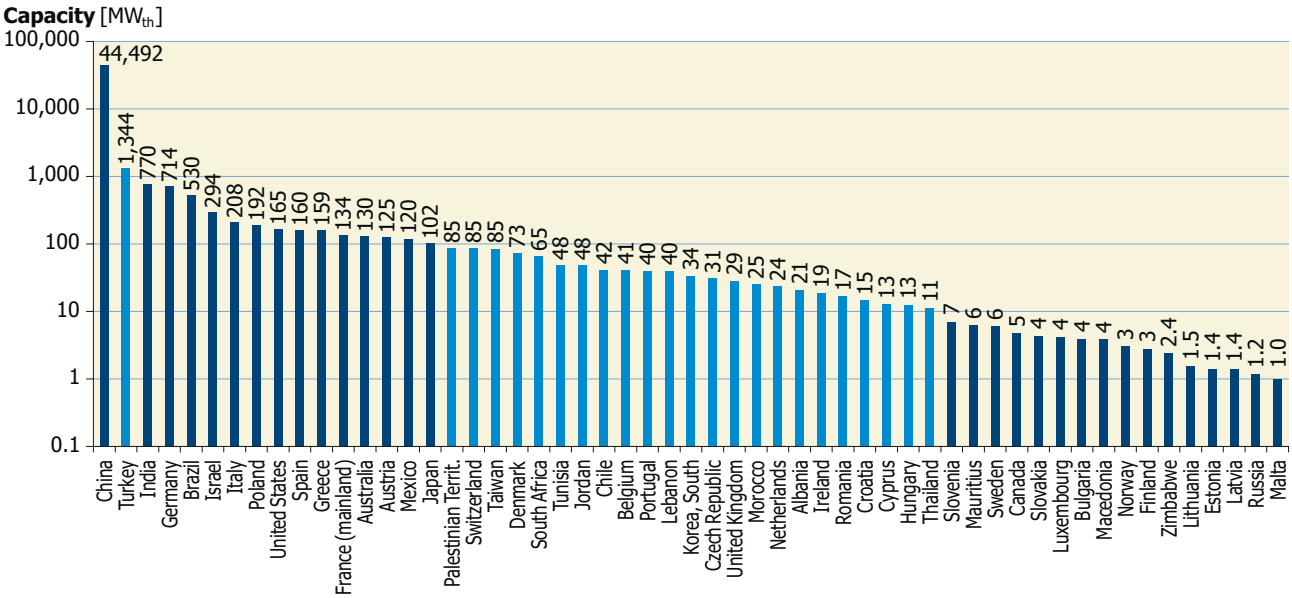


Figure 22: Newly installed capacity of glazed water collectors in 2013

In terms of newly installed glazed water collector capacity per 1,000 inhabitants, Israel is the leader ahead of China and the Palestinian Territories (**Figure 23**).

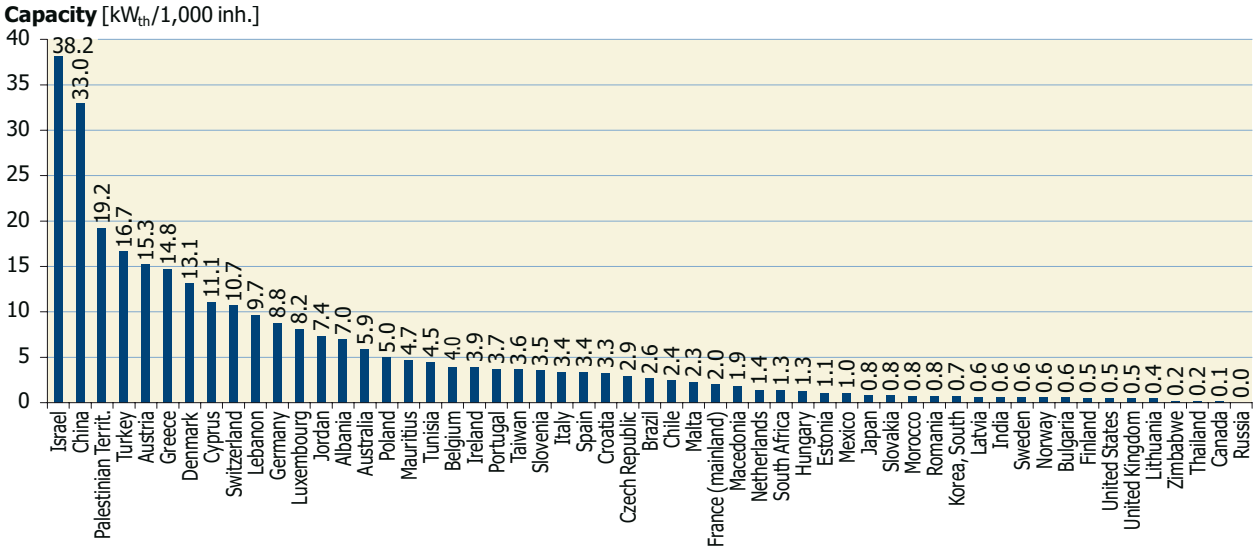
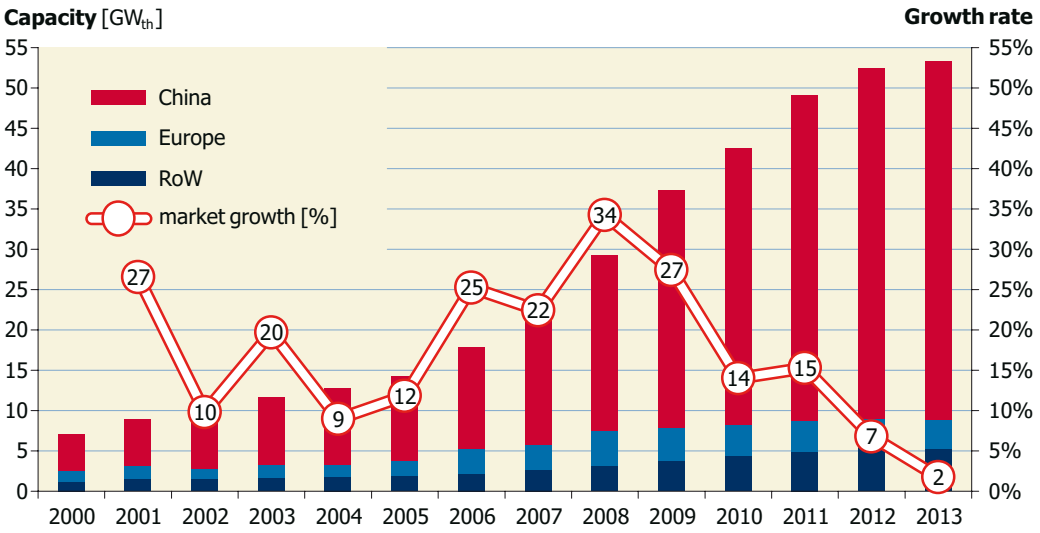


Figure 23: Newly installed capacity of glazed water collectors in 2013 in kW_{th} per 1,000 inhabitants

4.3 Market development of glazed water collectors between 2000 and 2013

The worldwide market of glazed water collectors was characterized by a steady upwards trend between 2000 and 2011 and shown a leveling trend since 2012. The annual installed capacity increased from around 9.8 GW_{th} in 2002 to around 53.3 GW_{th} in 2013. Compared to the year 2012, the growth rate has dropped from 6.8% to 1.7% in 2013 (**Figure 24**).



Europe: EU 28, Albania, Macedonia, Norway, Russia, Switzerland, Turkey
Rest of World (RoW): Asia (India, Japan, Korea South, Taiwan, Thailand), Australia, Canada, Latin America (Barbados, Brazil, Chile, Mexico, Uruguay), New Zealand, MENA Region (Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia), Sub-Sahara Africa (Mauritius, Mozambique, Namibia, South Africa, Zimbabwe), USA

Figure 24: Global market development of glazed water collectors from 2000 to 2013

In 2000 the Chinese market was about three times as large as the European market while in 2013 the Chinese market volume exceeded it thirteen-fold (**Figure 25**).

It can be also seen in **Figure 25** that after years of very high growth rates in China this trend ended and the market started to stagnate in 2012 and 2013. For the year 2014 preliminary market data from the Chinese Solar Thermal Industry Federation (CSTIF) reports a significant decline in sales numbers of –17.6%.

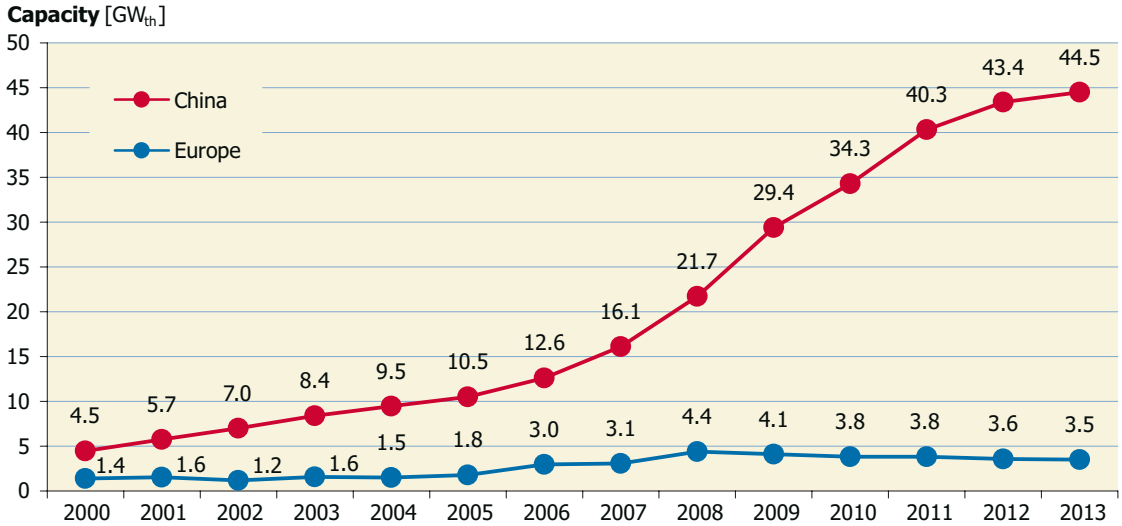


Figure 25: Market development of glazed water collectors in China and Europe

The European market peaked at 4.4 GW_{th} installed capacity in 2008 and decreased steadily down to 3.5 GW_{th} in 2013. By contrast, in the remaining markets worldwide (RoW) an upwards trend could be observed between 2002 and 2012 with a declining tendency as well in 2013 (**Figure 26**).

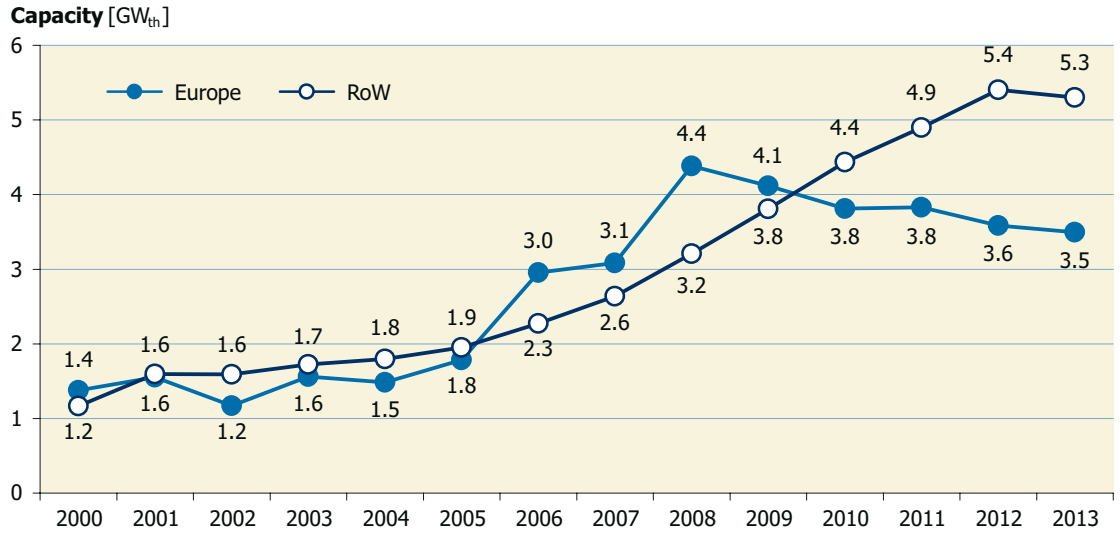


Figure 26: Market development of glazed water collectors in Europe and the rest of the world (RoW, excluding China)

RoW includes all economic regions other than China and Europe as well as "All other countries" not covered within this report. Of these regions, "All other countries", Asia (excluding China) and Latin America hold the largest market shares (see **Figure 27**).

"Asia excl. China" is highly influenced by the large Indian market, which dropped significantly in 2013, but also the markets in Japan, South Korea and Thailand decreased. In sum this led to a market decline of –20.3% for this economic region compared to a positive market growth rate of 38.6% in 2012. According to the Ministry of New and Renewable Energy (MNRE), the Indian authority responsible for solar heating statistics, in 2014 the Indian market recovered again.

The third largest region shown in **Figure 27** is Latin America showing a steady upwards trend mainly due to the well growing Brazilian market. The MENA region recovered from a market decline in 2012 with Israel as the most important market driver.

Sub-Sahara African markets, most notably South Africa, are growing slowly, United States and Canada are more or less stagnating while the Australian market is constantly shrinking. The annually installed capacity in the latter fell from 364 MW_{th} in 2009 to 130 MW_{th} in 2013.

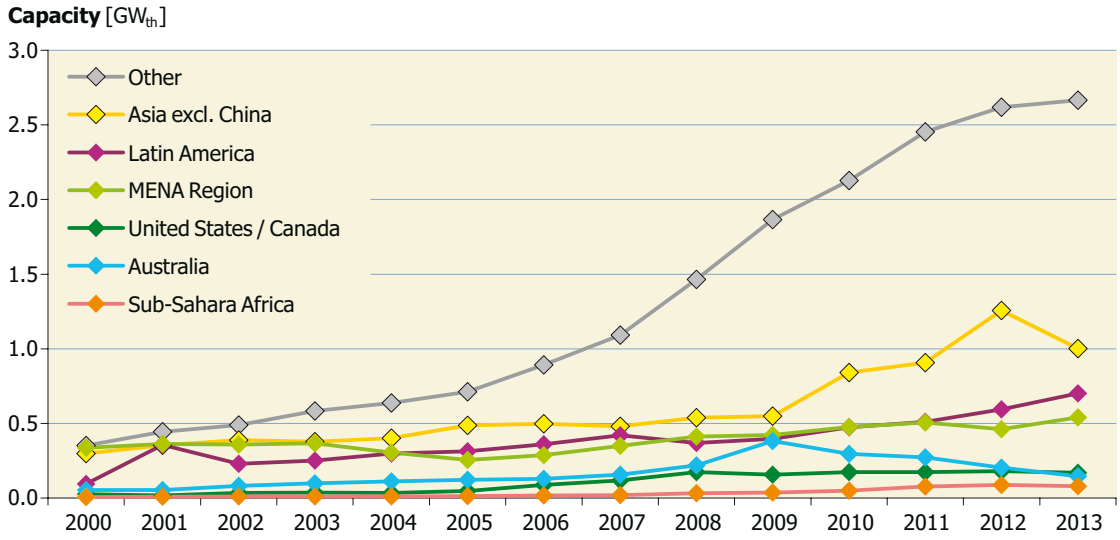


Figure 27: Market development of glazed water collectors in Rest of World (excluding China and Europe)

In relative figures, the annual global market volume for glazed water collectors grew from 1.2 kW_{th} per 1,000 inhabitants in 2000 to 7.5 kW_{th} per 1,000 inhabitants in 2012 (**Figure 28**).

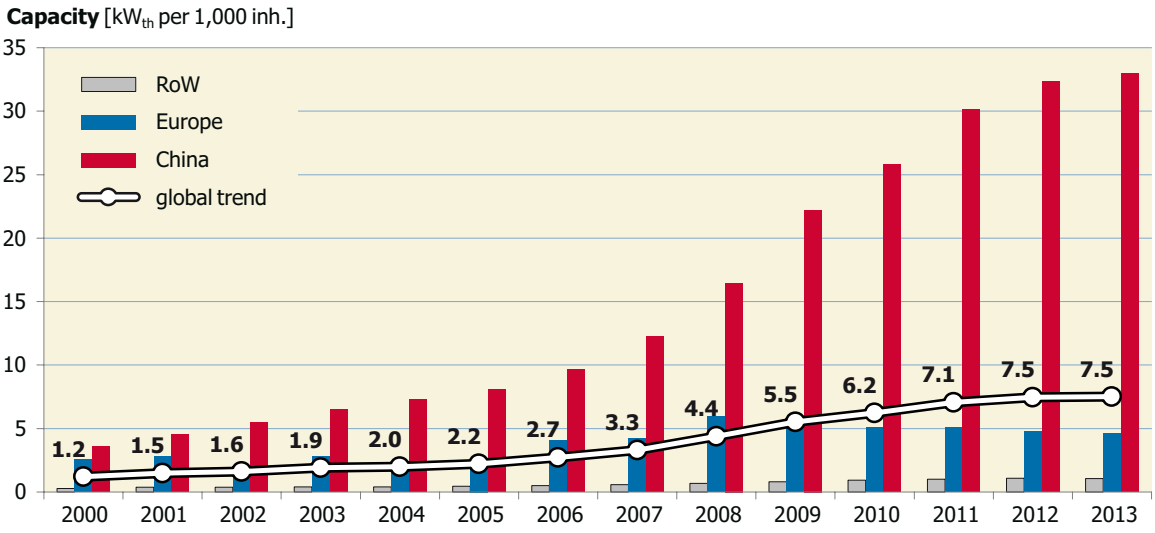


Figure 28: Annual installed capacity of glazed water collectors in kW_{th} per 1,000 inhabitants from 2000 to 2013

It can be highlighted that in 2013 China had the second highest market penetration in terms of glazed water collector installations per capita compared to all other countries covered in this report. The annually installed capacity rose from 3.5 kW_{th} per 1,000 inhabitants in 2000 to 33.5 kW_{th} per 1,000 inhabitants in 2013. Worldwide, only Israel showed a higher market penetration of 38.2 kW_{th} per 1,000 inhabitants in 2013 as can be seen in **Figure 23**.

In Europe, the market penetration peaked in 2008 with 5.9 kW_{th} per 1,000 inhabitants and since then a constant downwards trend in per capita installations can be observed leading to a value of 4.7 kW_{th} per 1,000 inhabitants in 2013.

4.4 Market development of unglazed water collectors between 2000 and 2013

In 2013 unglazed water collectors accounted for 3.1% of the total installed capacity (**Figure 18**) and compared to the year 2012 the market grew moderately by 1.5%.

The most important markets for unglazed collectors in 2013 were the United States (540 MW_{th}), Australia (455 MW_{th}) and Brazil (435 MW_{th}). These three countries accounted for 85% of the recorded unglazed water collector installations.

Another 10% were installed in Mexico (69 MW_{th}), South Africa (35 MW_{th}), the Czech Republic (25 MW_{th}), the Netherlands (19 MW_{th}) and Canada (15 MW_{th}).

RoW includes several smaller markets in Europe and the MENA region as well as "other countries" not considered in this report and hence estimated to be 5% of the total market for unglazed water collectors.

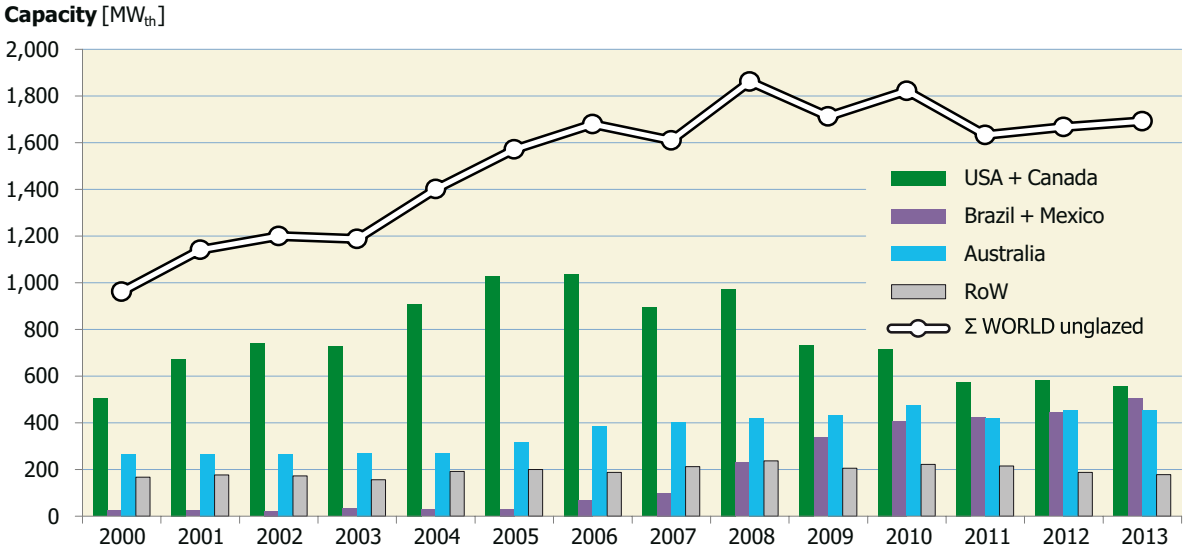


Figure 29: Global market development of unglazed water collectors from 2000 to 2013

The unglazed water collector market in the United States peaked in 2006 (1.01 GW_{th}) and almost halved since then (0.54 GW_{th} in 2013). Nevertheless, the annual market volume for unglazed water collectors remained at quite a constant level because of the Brazilian market, which entered in 2007 and has grown steeply since then.

5 Contribution to the energy supply and CO_2 reduction

In this section, the contribution of the total installed glazed and unglazed water collectors in operation to the thermal energy supply and CO_2 reduction is shown.

The basis for these calculations is the total glazed and unglazed water collector area in operation in each country as shown in **Table 1**. The contribution of the total installed air collector capacity in operation in 2013 of 1.7 GW_{th} was not taken into consideration – with a share of around 0.4% of the total installed collector capacity these collectors were omitted from the calculation.

The results are based on calculations using the simulation tool T-SOL expert 4.5 (www.valentin-software.com) for each country. For the simulations, different types of collectors and applications as well as the characteristic climatic conditions were considered for each country. A more detailed description of the methodology can be found in the appendix (see Chapter 8).

The annual collector yield of all water-based solar thermal systems in operation by the end of 2013 in the 60 recorded countries was 314 TWh (= 1,129 PJ). This corresponds to an energy savings equivalent of 33.7 million tons of oil and 109 million tons of CO_2. The calculated number of different types of solar thermal systems in operation was around 111 million (**Table 5**).

The most important field of application for solar thermal systems is heating domestic hot water (see section 6.3), and therefore, this type of application also accounted for the highest savings in terms of oil equivalent and CO_2. In 2013, 94% of the energy provided by solar thermal systems worldwide was used for heating domestic hot water, mainly by small-scale systems in single family houses (84%) and larger applications attached to multi-family houses, hotels, schools, etc. (10%). Swimming pool heating held a share of 4% in the contribution to the energy supply and CO_2 reduction and the remaining 2% were met by solar combi systems.

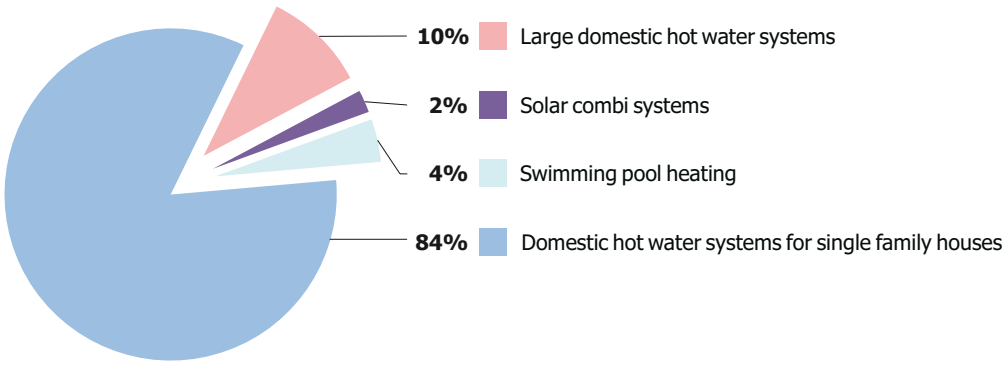


Figure 30: Share of energy savings and CO_2 reduction by type of application of glazed and unglazed water collectors in operation by the end of 2013

Table 5 summarizes the calculated annual collector yields and the corresponding oil equivalents and CO_2 reductions of all water-based solar thermal systems (systems for hot water, space heating and swimming pool heating) in operation by the end of 2013.

Country	Total collector area [m²]	Total capacity [MW_{th}]	Calculated number of systems	Collector yield [GWh/a]	Energy savings [t_{oe}/a]	CO_2 reduction [t_{CO2}/a]
Albania	141,885	99	18,188	99	10,664	34,473
Australia	8,023,000	5,616	1,024,556	4,992	536,591	1,734,637
Austria	5,056,098	3,539	503,348	2,044	219,716	710,276
Barbados	131,690	92	26,977	112	12,024	38,869
Belgium	487,783	341	99,922	199	21,379	69,112
Brazil	9,609,263	6,726	1,549,301	6,407	688,607	2,226,059
Bulgaria	126,200	88	23,209	66	7,071	22,859
Canada	889,370	623	14,894	423	45,489	147,051
Chile	139,309	98	17,525	105	11,232	36,310
China	374,660,000	262,262	85,403,747	217,841	23,413,743	75,689,608
Croatia	145,565	102	29,819	75	8,093	26,164
Cyprus	700,947	491	154,463	623	66,964	216,475
Czech Republic	971,269	680	68,205	332	35,636	115,202
Denmark	785,090	550	91,965	335	35,964	116,260
Estonia	8,520	6	1,745	4	379	1,225
Finland	52,202	37	10,694	22	2,358	7,621
France (mainland)	2,370,399	1,659	372,260	1,144	122,955	397,476
Germany	17,514,176	12,260	1,915,127	7,124	765,699	2,475,274
Greece	4,178,350	2,925	1,612,857	3,207	344,706	1,114,330
Hungary	252,100	176	29,185	114	12,215	39,489
India	6,231,200	4,362	1,125,978	5,221	561,170	1,814,094
Ireland	277,619	194	64,250	116	12,493	40,386
Israel	4,150,115	2,905	1,372,992	3,888	417,912	1,350,983
Italy	3,692,896	2,585	632,778	2,266	243,579	787,419
Japan	4,074,396	2,852	995,253	2,366	254,254	821,926
Jordan	1,192,270	835	211,031	1,129	121,342	392,261
Korea, South	1,762,570	1,234	254,163	871	93,632	302,683
Latvia	6,040	4	1,237	3	286	923
Lebanon	561,000	393	60,251	465	49,934	161,421
Lithuania	8,200	6	1,680	4	380	1,229
Luxembourg	45,800	32	9,382	20	2,134	6,899
Macedonia	47,130	33	10,613	29	3,131	10,122
Malta	48,448	34	9,925	40	4,320	13,966
Mauritius	115,113	81	61,952	94	10,139	32,777
Mexico	2,497,077	1,748	129,536	1,372	147,472	476,732
Morocco	415,000	291	85,013	354	38,076	123,089
Mozambique	416	0	85	0	36	118
Namibia	22,006	15	2,718	20	2,158	6,975
Netherlands	880,450	616	132,899	310	33,302	107,655
New Zealand	159,645	112	32,703	99	10,592	34,241
Norway	39,576	28	1,502	15	1,573	5,084
Palestinian Territ.	1,627,000	1,139	979,454	1,580	169,832	549,015
Poland	1,485,000	1,040	186,863	606	65,177	210,698
Portugal	904,629	633	172,974	701	75,370	243,650
Romania	128,550	90	26,333	73	7,864	25,422
Russia	18,213	13	825	8	815	2,635
Slovakia	150,200	105	20,755	71	7,603	24,577
Slovenia	186,800	131	28,250	78	8,353	27,003
South Africa	1,506,611	1,055	148,948	1,056	113,516	366,964
Spain	3,195,339	2,237	375,932	2,228	239,497	774,222
Sweden	454,000	318	34,572	166	17,835	57,655
Switzerland	1,384,940	969	167,565	547	58,786	190,038
Taiwan	1,545,628	1,082	304,849	940	101,082	326,767
Thailand	136,611	96	27,985	110	11,871	38,376
Tunisia	706,380	494	247,039	635	68,239	220,596
Turkey	15,670,321	10,969	3,629,246	14,059	1,511,076	4,884,855
United Kingdom	743,873	521	152,382	297	31,924	103,200
United States	23,842,764	16,690	733,165	10,873	1,168,663	3,777,936
Uruguay	12,571	9	2,575	8	884	2,859
Zimbabwe	22,978	16	4,707	19	2,042	6,602
All other countries	26,641,715	18,649	5,472,916	15,682	1,685,544	5,448,859
TOTAL	532,834,306	372,984	110,881,263	313,688	33,715,371	108,991,678

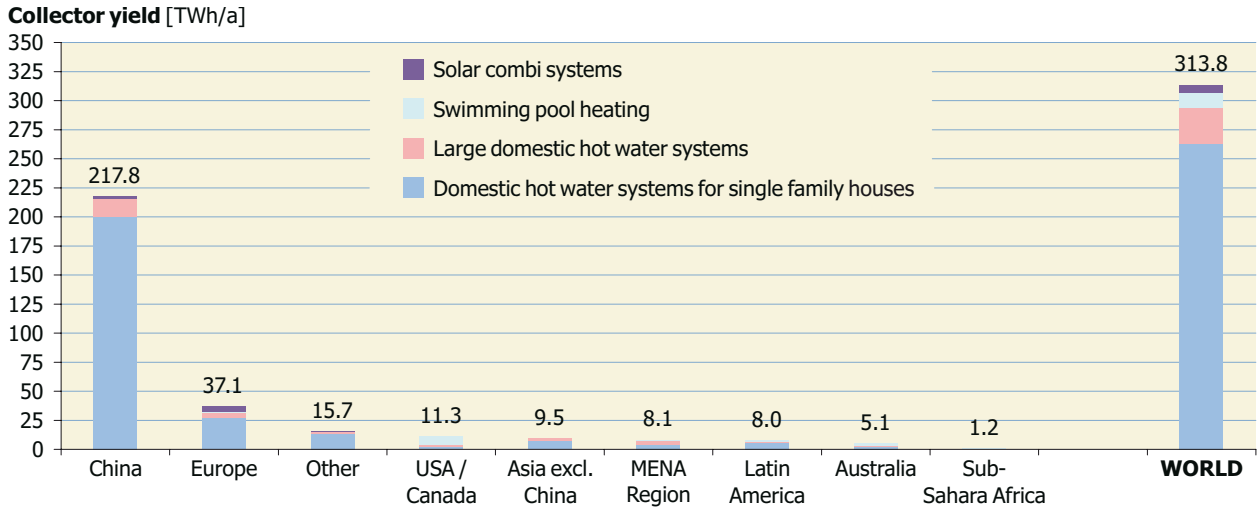
Table 5: Calculated annual collector yield and corresponding oil equivalent and CO_2 reduction of glazed and unglazed water collectors in operation by the end of 2013

In Chapters 5.1 to 5.3, the annual collector yield, energy savings and CO_2 savings by economic regions and worldwide are graphed.

5.1 Annual collector yield by economic region

In 2013 gross solar thermal collector yields amounted to 314 TWh worldwide (**Table 5**) and the major share, 84%, was contributed by domestic hot water applications for single family houses (**Figure 30**).

China accounted for 69% of the thermal energy gains (218 TWh), Europe for 12% (37 TWh) and the Rest of the World for 19% (42 TWh) (**Figure 31**).



Sub-Sahara Africa:	Mauritius, Mozambique, Namibia, South Africa, Zimbabwe
Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Latin America:	Barbados, Brazil, Chile, Mexico, Uruguay
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MENA Region:	Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Figure 31: Annual collector yield of unglazed and glazed water collectors in operation by end of 2013

5.2 Annual energy savings by economic region

Considering an utilization ratio of 0.8 for the reference oil boiler, which is assumed to be partly replaced by the solar thermal system (see methodology Chapter 8.1), the annual final energy savings amounted to 314 TWh or 33.7 million tons of oil equivalent in 2013[5].

The breakdown shows that China accounted for 23.4 million tons oil equivalent; Europe for 4.0 million tons oil equivalent, Rest of World for 6.3 million tons oil equivalent (**Figure 32**).

5 1 toe = 1.163 x 10^4 kWh (Defra/DECC 2013)

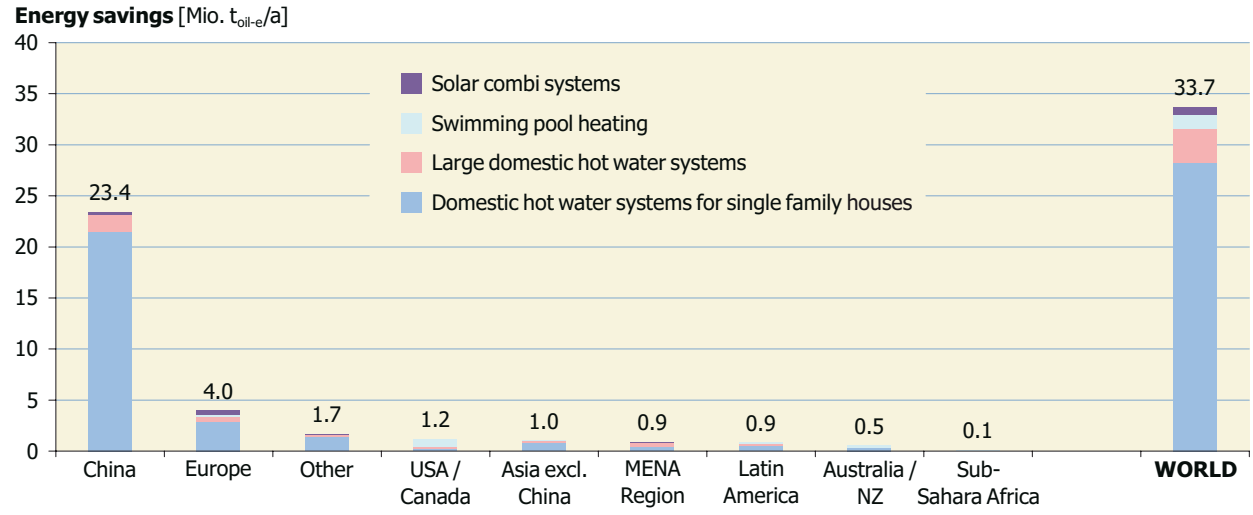
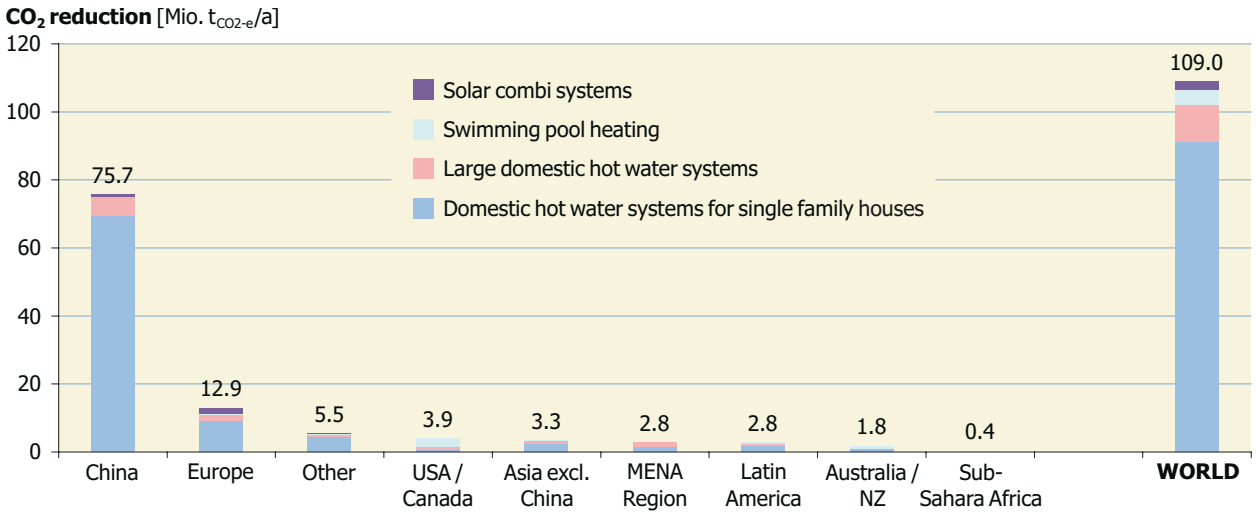


Figure 32: Annual energy savings in oil equivalent by unglazed and glazed water collectors in operation by end of 2013

5.3 Annual contribution to CO_2 reduction by economic region

33.7 million tons of oil equivalents correspond to an annual CO_2 emission reduction of 109 million tons[6]. Here, the breakdown was China 75.7 million tons of CO_2e; Europe 12.9 million tons of CO_2e, Rest of World 20.4 million tons of CO_2e (see **Figure 33**).



Sub-Sahara Africa:	Mauritius, Mozambique, Namibia, South Africa, Zimbabwe
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Figure 33: Contribution to CO_2 reduction by unglazed and glazed water collectors in operation by end of 2013

6 1 toe (fuel oil) = 3,232.7 kgCO_2e (Defra/DECC 2013)

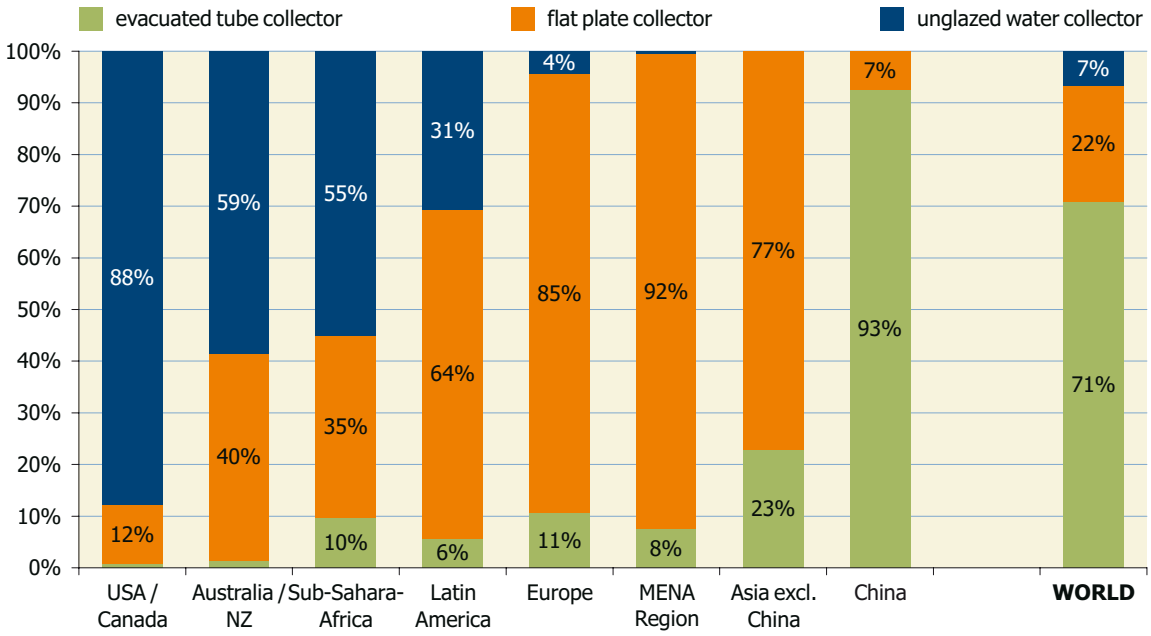
6 Distribution of systems by system type and application

The use of solar thermal energy varies greatly from region to region and can be roughly distinguished by the type of solar thermal collector used (unglazed water collectors, evacuated tube collectors, flat plate collectors, glazed and unglazed air collectors, concentrating collectors), the type of system operation (pumped solar thermal systems, thermosiphon systems), and the main type of application (swimming pool heating, domestic hot water preparation, space heating, others such as heating of industrial processes, solar district heating or solar thermal cooling).

In **Chapters 6.1** to **6.3**, the share of these system types and applications are shown by different economic regions for both the cumulated capacity in operation by the end of 2013 and the newly installed capacity in 2013[7].

6.1 Distribution by type of solar thermal collector

In terms of the total water collector area, evacuated tube collectors dominated with a share of 71% of the cumulated capacity in operation (**Figure 34**) and a share of 79% of the newly installed capacity (**Figure 35**). Especially in China, vacuum tube collectors played an important role and since this was by far the largest market supported by high growth rates in the past, the worldwide figures tend towards a higher share of this type of solar thermal collector. Unglazed water collectors accounted for 7% of the cumulated water collectors installed worldwide and for 3% of the newly installed capacity.



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MENA Region:	Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Figure 34: Distribution by type of solar thermal collector for the total installed water collector capacity in operation by the end of 2013

7 It has to be considered that statistical information summarized in Chapters 6.1 to 6.4 is sometimes based on rough expert estimations by country representatives only and hence especially the share by type of system and application of the cumulated installed capacity in operation may deviate from figures published in previous editions of this report.

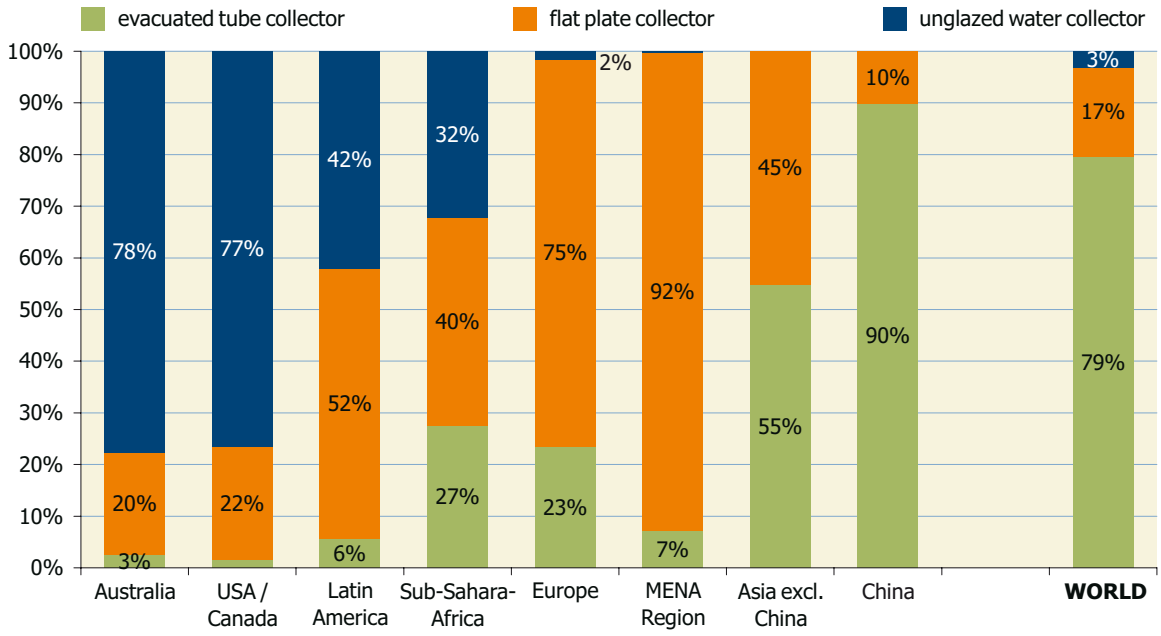

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Figure 35: Distribution by type of solar thermal collector for the newly installed water collector capacity in 2013

6.2 Distribution by type of system

Worldwide, more than three quarters of all solar thermal systems installed are thermosiphon systems and the rest are pumped solar heating systems (**Figure 36**). Similar to the distribution by type of solar thermal collector in total numbers the Chinese market influenced the overall figures most, and in 2013 90% of the newly installed systems were estimated to be thermosiphon systems while pumped systems only accounted for 10% (**Figure 37**).

In general, thermosiphon systems are more common in warm climates such as in Africa, South America, southern Europe and the MENA region. In these regions thermosiphon systems are more often equipped with flat plate collectors, while in China, the typical thermosiphon system for domestic hot water preparation is equipped with evacuated tubes.

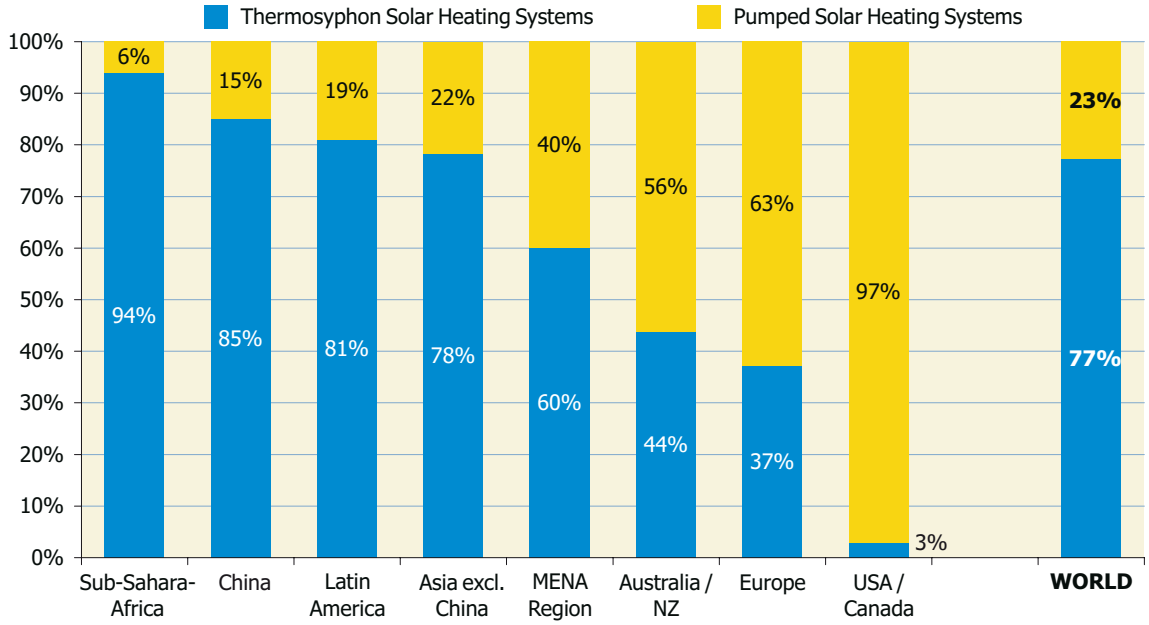

Figure 36: Distribution by type of system for the total installed glazed water collector capacity in operation by the end of 2013

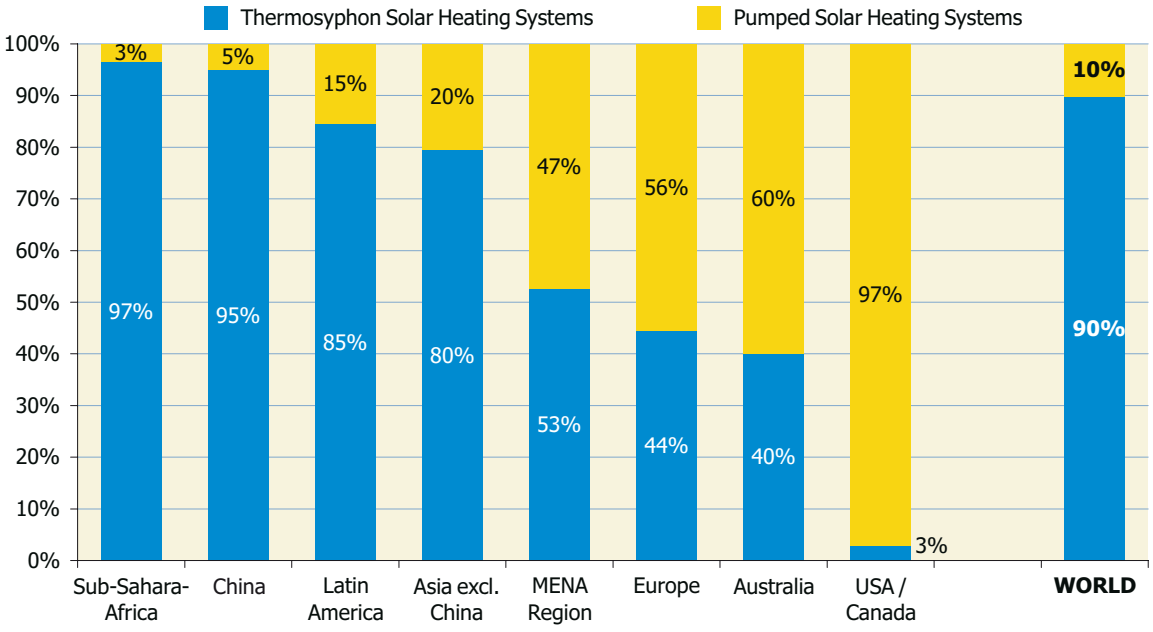

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Figure 37: Distribution by type of system for the newly installed glazed water collector capacity in 2013

6.3 Distribution by kind of application

The calculated number of water-based solar thermal systems in operation by the end of 2013 was about 111 million (**Table 5**). Out of these, 6% were used for swimming pool heating, 80% were used for domestic hot water preparation in single family houses and 9% were attached to larger domestic hot water systems for multifamily houses, hotels, hospitals, schools, etc. Around 3% of the worldwide installed capacity supplied heat for both domestic hot water and space heating (solar combi-systems). The remaining systems accounted for around 1% or 4.9 million square meters of solar thermal collectors and delivered heat to district heating networks, industrial processes or thermally driven solar cooling applications (**Figure 38**).

Compared to the cumulated installed capacity, the share of swimming pool heating was less for new installations (6% of total capacity and 3% of newly installed capacity). A similar trend can be seen for domestic hot water systems in single family homes: 80% of total capacity in operation and 77% of new installations in 2013 make this kind of systems the most common application world-wide but with a slightly decreasing tendency.

By contrast the share of large-scale domestic hot water applications tended to increase (9% of total capacity and 17% of newly installed capacity). It can be assumed that this market segment took over some of the market shares from both swimming pool heating and domestic hot water systems in single family homes.

The share of solar combi-systems as well as other applications, such as solar district heating, solar process heat or solar cooling remained at a low level of 3–4% and no real trend can be identified in a global context (**Figure 39**).

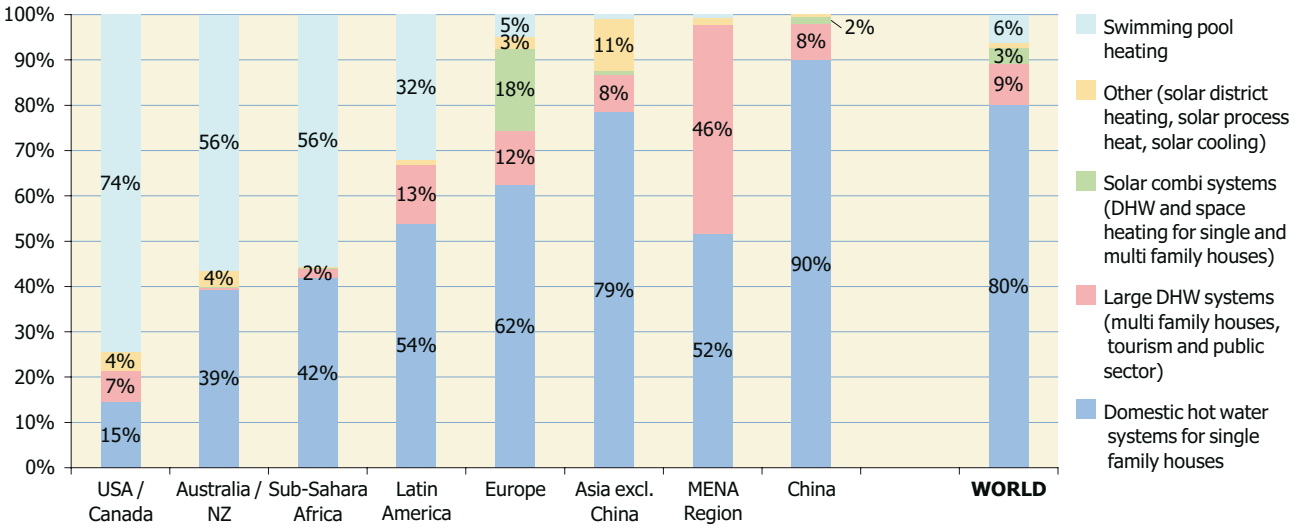

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Figure 38: Distribution of solar thermal systems by application for the total installed water collector capacity by economic region in operation by the end of 2013

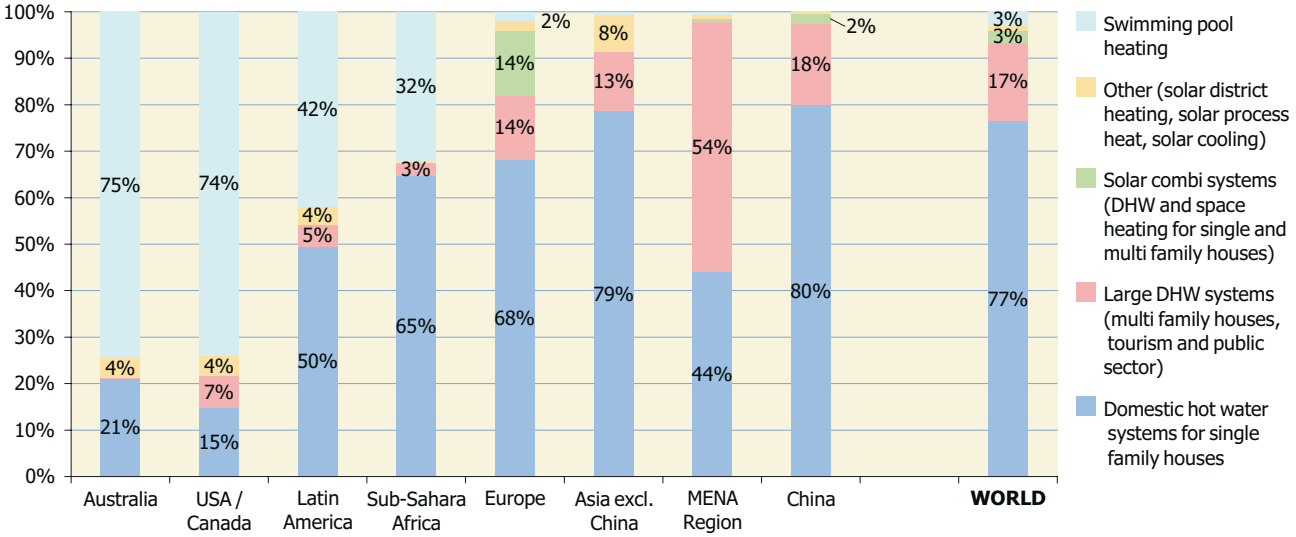

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Figure 39: Distribution of solar thermal systems by application for the newly installed water collector capacity by economic region in 2013

7 Exceptional markets and applications for solar thermal systems

7.1 Overview of global megawatt-scale solar thermal applications

Megawatt-scale solar supported district heating systems and solar heating and cooling applications in the commercial and industrial sector have gained increasing interest all over the world in recent years, and several ambitious projects have been successfully implemented.

Two of the largest solar thermal systems worldwide are located in Denmark and supply heat to district heating networks. In May 2014 a 26 MW_{th} (37,573 m²) installation was inaugurated in the Danish town of Dronninglund. The ground-mounted flat plate collector field is hydraulically connected to seasonal pit heat storage with a volume of 61,700 m³ and is designed to cover around 50% of the annual district heating demand of the 1,350 costumers connected in future[8, 9]. The construction of an even larger solar district heating application with seasonal storage began later in 2014 in the Danish city of Vojens and commissioning is planned for mid-2015. This new world's largest solar thermal system with a thermal capacity of 37 MW_{th} (52,491 m²) is going to be connected to a huge seasonal pit heat storage with a volume of 203,000 m³. Together with an already existing 13 MW_{th} (17,500 m²) installation at Vojens district heating, a total solar thermal capacity of 50 MW_{th} (69,991 m²) will deliver 55–60% of the thermal energy demand of 2,000 households[10, 11].

In Riyadh, Saudi Arabia another large-scale solar district heating plant was commissioned in July 2011. The solar thermal plant with a total capacity of 25.4 MW_{th} (36.305 m²) is connected to a heating network for the supply of space heating and domestic hot water at a university campus[12]. Another successful solar supported heating network was implemented in Alberta, Canada. The Drake Landing Solar Community uses a 1.6 MW_{th} (2.293 m²) centralized solar thermal plant connected to a seasonal borehole thermal energy storage to supply more than 90% of the energy needed for space heating of 52 energy efficient single family homes[13, 14].

Probably the two largest solar cooling applications worldwide are in Singapore and the USA. In August 2011 a solar cooling installation with a total capacity of 2.73 MW_{th} (3,900 m²) started operation at the United World College in Singapore. The roof mounted solar thermal collector field is hydraulically connected to a 1.76 MW_{th} absorption chiller and supplies hot water and cooling to approximately 2,900 students who live and study at the newly created 76,000 m² campus[15]. The largest solar cooling application is located in Arizona, USA and was commissioned in May 2014. The installation covers a roof-mounted solar thermal collector field with a capacity of 3.4 MW_{th} (4,865 m²) that supplies heat to a single-effect lithium bromide absorption chiller with a cooling capacity of 1.75 MW[16, 17].

8 http://www.solarthermalworld.org/content/denmark-dronninglund-inaugurates-26-mwth-solar-district-heating-plant
9 http://www.solarthermalworld.org/content/denmark-23-mwth-cover-55-heat-demand-1500-households
10 http://www.solarthermalworld.org/content/denmark-37-mw-field-203000-m3-storage-underway
11 http://www.arcon.dk/NY_Referencer.aspx
12 http://www.solarthermalworld.org/content/saudi-arabia-womens-university-solar-district-heating
13 http://www.solarthermalworld.org/content/canada-district-heating-90-solar-fraction
14 http://www.dlsc.ca/
15 http://www.solarthermalworld.org/content/singapore-second-largest-solar-cooling-installation-worldwide
16 http://www.solarthermalworld.org/content/usa-largest-solar-cooling-system-worldwide
17 http://www.solid.at/en/references/solar-cooling

The world's largest solar process heat application was commissioned in Chile in June 2013. The installation with a thermal peak capacity of 27.5 MW covers a total of 39,300 m² of flat plate collector area connected to 4,000 m³ thermal energy storage. The solar thermal system is designed to cover 85% of the process heat demand needed to refine copper at the Gaby copper mine of state-owned mining company Codelco[18].

In the USA, probably the largest solar thermal system is a solar process heat application that was dedicated in April 2012 in North Carolina. The 5.5 MW_{th} (7,804 m²) solar thermal system equipped with flat plate collectors supplies hot water to a turkey processing plant, lessening the use of propane gas[19].

The largest solar process heat applications installed in China are connected to dyeing and weaving mill factories. A system with a thermal peak capacity of 9.1 MW_{th} (13,000 m²) was constructed in the province of Zhejiang and two other projects of 10.5 MW_{th} (15,000 m²) have been commissioned in the neighboring province of Jiangsu.

More examples of solar process heat applications can be found at http://ship-plants.info/.

7.2 Large-scale solar district heating and cooling applications in Europe

In the Scandinavian countries of Denmark and Sweden, but also in Austria, Germany, Spain and Greece large-scale solar thermal applications connected to local or district heating grids have been in use since the early 1980s.

By the end of 2014, 210 large-scale solar thermal systems >350 kW_{th} (500 m²) connected to heating networks and 17 systems connected to cooling networks were in operation in Europe. The total installed capacity of these systems equaled 551 MW_{th} (≈787,500 m²).

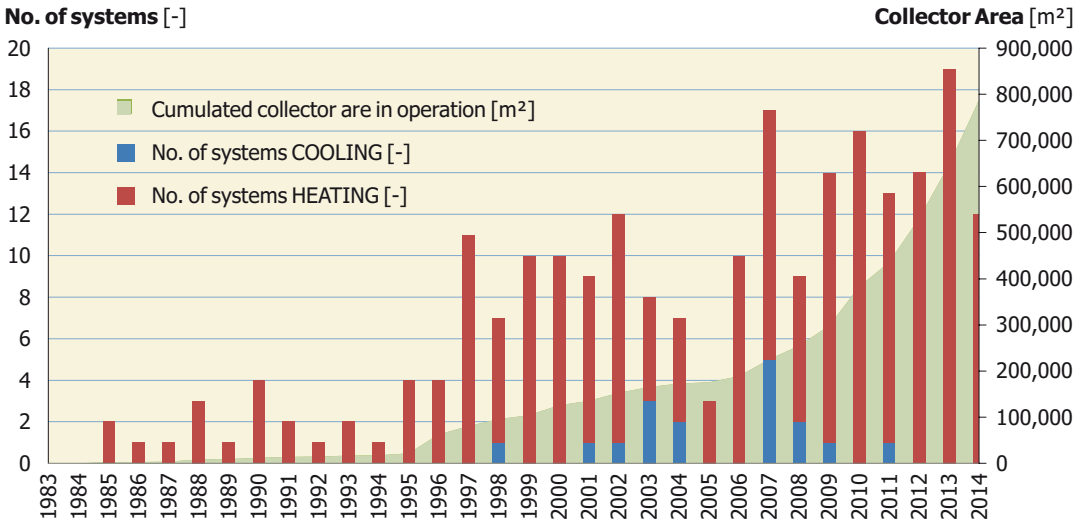


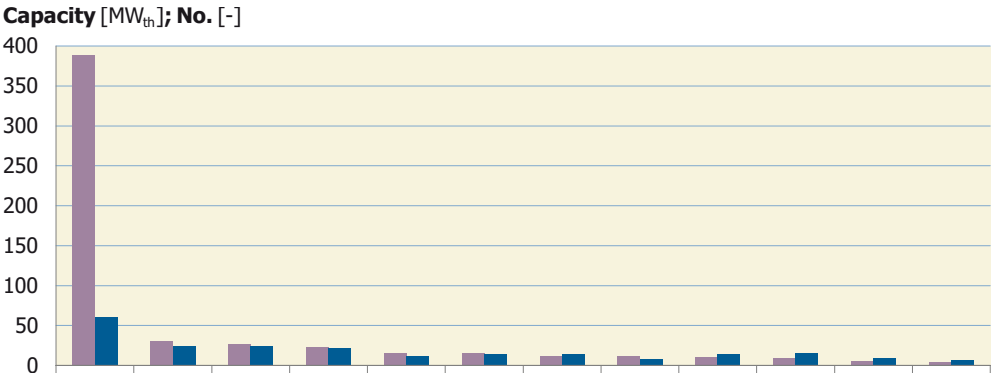
Figure 40: Solar district heating and cooling in Europe – annual achievements and cumulated area in operation by end of 2014 *(Data source: Jan-Olof Dalenbäck - Chalmers University of Technology, SE)*

18 http://www.solarthermalworld.org/content/chile-president-inaugurates-solar-field-275-mwth

19 http://solarthermalworld.org/content/usa-contractor-runs-7804-m2-collector-system-prestage-foods-factory

Denmark by far holds the leading position in Europe with both large-scale systems installed as well as capacity installed. By end of 2014 sixty-one solar district heating plants with a total installed capacity of 389 MW_{th} (555,626 m²) were in operation in Denmark. The average system size of these plants calculates to 6.4 MW_{th} (9,100 m²). Most of the Danish installations are ground mounted flat plate collector fields hydraulically connected to load-balancing storages in close distance to the district heating main distribution line. The largest plants in operation are located in Dronninglund (26.3 MW_{th}; 37,573 m²) and Marstal (23.3 MW_{th}; 33,300 m²) and are equipped with seasonal pit heat storages and additional thermal or compression heat pumps for solar fractions of around 50%. Even larger plants, such as the huge 50 MW_{th} (70,000 m²) installation in Vojens are currently under construction (see chapter 7.1)[20].

In Europe and worldwide, Denmark is the only example for a mature and commercial solar district heating market. In several other countries smaller niche markets exist, such as in Austria where 25 systems >500 m² are installed to feed into district heating networks, smaller micro grids in urban quarters or local biomass heating networks. In Germany, several remarkable demonstration plants with seasonal storage were built and also from other countries such as Sweden (22 plants), Spain (16 plants), Greece, France, Poland (14 plants) and Switzerland (9 plants) interesting achievements are reported.



	DK	DE	AT	SE	OTH	PL	GR	NL	FR	ES	CH	IT
Capacity [MW_{th}]	389	30	27	22	16	15	11	11	10	9	6	4
No. of systems [-]	61	25	25	22	12	14	14	8	14	16	9	7

Figure 41: Solar district heating and cooling in Europe – capacities installed and No. of systems by end of 2014
(Data source: Jan-Olof Dalenbäck - Chalmers University of Technology, SE)

Large-scale solar cooling applications have been built in southern European countries with high cooling loads. In Italy (5 plants) and Spain (5 plants) several best practice examples exist.

20 The market for solar supported district heating networks in Denmark has been booming for several years and is driven by high taxes for fossil fuels and an energy supply system that is characterized by decentralization on the one hand and a high share of wind energy for electricity production on the other hand. This together with the liberalized market mechanisms for electricity in Europe and low solar thermal system prices for large-scale systems make solar thermal heat in Denmark even competitive against natural gas driven combined heat and power systems in many cases. Actual levelized costs for solar thermal generated heat in Denmark amount to 30 – 40 €/MWh. More information about the (Danish) Solar District Heating success story in Europe can be found here: http://www.solar-district-heating.eu/. A database of techno-economic benchmark figures and monitoring data of several Danish best practice examples can be accessed here: http://www.solvarmedata.dk/index.asp?secid=228

7.3 Market for solar air conditioning and cooling applications

Solar cooling applications convert the energy from the sun into cold by means of driving a thermal cooling machine.

By the end of 2014, an estimated 1,175 solar cooling systems were installed worldwide. The market showed a positive trend between 2004 and 2014, but the growth rates tended to decrease from 32% in 2007/2008 to 12% in 2013/2014.

Approximately three quarters of the solar cooling installations worldwide are installed in Europe, most notably in Spain, Germany and Italy. The majority of the solar air conditioning and cooling applications installed is equipped with high performance flat plate or evacuated tube collectors. By contrast some examples for thermal cooling machines driven by concentrating solar thermal collectors (e.g. parabolic troughs or Fresnel collectors) were reported from India, Australia and Turkey[21].

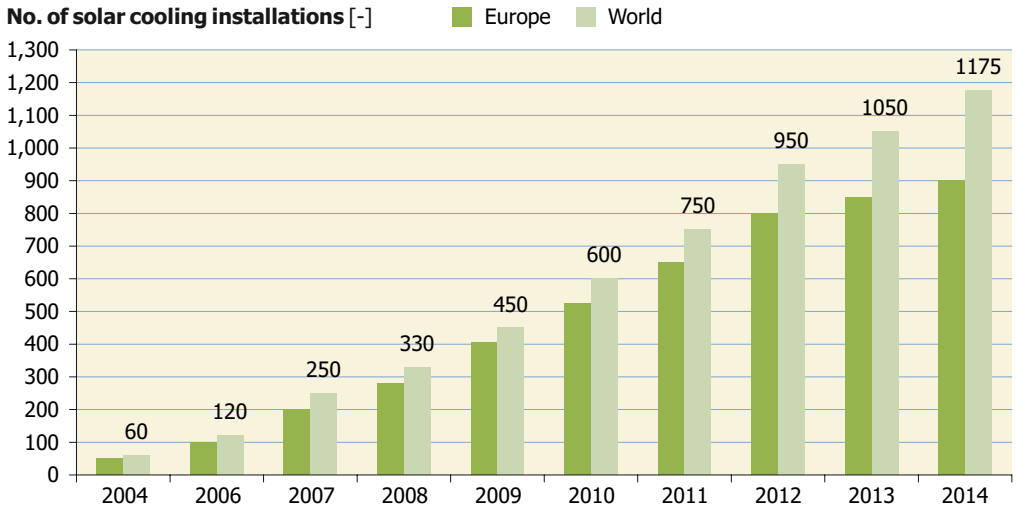


Figure 42: Market development 2004–2014 solar air conditioning and cooling systems in Europe and world-wide *(Source: Climasol, EURAC, Fraunhofer ISE, Green Chiller, Rococo, Solem Consulting, Tecsol)*

7.4 Best practice examples of worldwide installed solar process heat applications

A variety of industrial processes demand vast amounts of thermal energy, which makes the industrial sector a promising market for solar thermal applications. Depending on the temperature level of the needed heat, different types of solar thermal collectors are used—air collectors, flat plate and evacuated tube collectors for temperatures at or below 100°C to concentrating solar thermal collectors such as parabolic troughs, Fresnel collectors or Scheffler dishes for temperatures up to 400°C.

Solar Heat for Industrial Processes (SHIP) is still a niche market, but a number of promising projects have been realized in the last couple of years ranging from small-scale demonstration plants to very large systems, such as the

21 Jakob U. (2013): Status and Perspective of Solar Cooling outside of Australia; Australian Solar Cooling 2013 Conference, Sydney 2013

world's second largest solar thermal plant in Chile, which delivers heat for the leaching process at a copper mine (see section 7.1).

Currently, 151 SHIP applications are reported to be in operation all over the world with a cumulated installed capacity of around 100 MW_{th} (143,226 m²). Of these installations, 19 systems exceed 0.7 MW_{th} (1,000 m²) of thermal peak capacity, 31 systems have installed capacities of between 0.35 and 0.7 MW_{th} (500–1,000 m²) and 101 systems are below 0.35 MW_{th}.

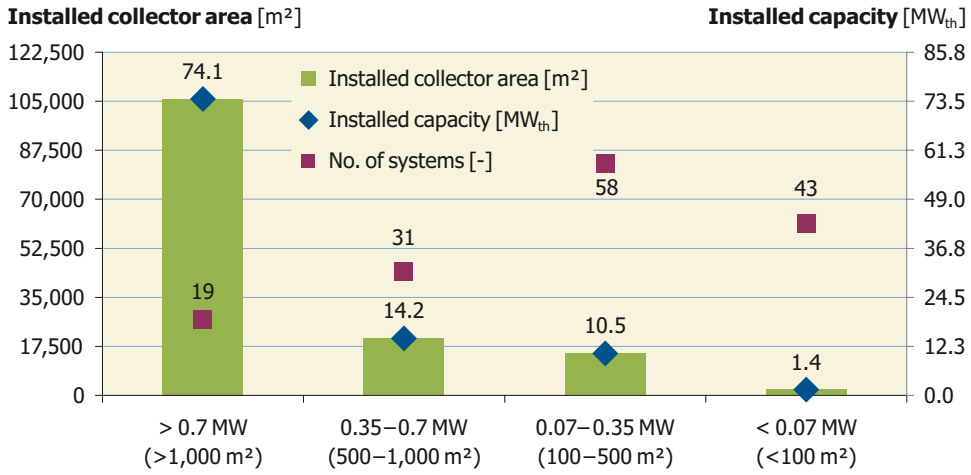


Figure 43: Global solar process heat applications in operation *(Source: IEA SHC Task49/IV SHIP database)*

Further information on the mentioned solar process heat applications in operation are collected in an online database that was created within the framework of IEA SHC Task 49/IV on "Solar Heat Integration in Industrial Processes"[22].

The SHIP database can be accessed by private users and it is the intention to continuously add new and existing SHIP applications in order to spread knowledge about the possibilities offered by this technology. The database can be found at http://ship-plants.info/.

7.5 Market for Solar Air Heating Systems

Solar air heating is a solar thermal technology in which the energy from the sun heats air. In colder climates, space heating is usually the largest use of building energy and it is the air in the buildings that is heated. Space heating consumes much more energy than hot water in most buildings. Solar air heating systems can be building integrated and typically reduce between 20–30% of conventional energy used for heating buildings.

The air is generally taken off the top of the wall (since hot air rises) and the heated or pre-heated fresh air is then connected to fans and ducted into the building via the ventilation system.

Solar air heaters are also common in agricultural applications primarily for drying.

22 http://task49.iea-shc.org/

Solar air heating systems have been used globally for the past 30 years by schools, municipalities, military, agricultural, commercial and industrial entities as well as in residential buildings. Wall mounted systems are common and take advantage of the lower winter sun angles and eliminate any snow accumulation typical of roof mounted systems. Storage of the heat is possible, but most solar air systems do not include storage to minimize costs.

Solar space heating with air collectors has not been common in Europe, likely due to the lack of a European test standard for air collectors, but in North America building integrated solar air collectors are the most popular form of solar thermal systems in the commercial, industrial and institutional markets due to their low cost and architectural integration into buildings.

8 Appendix

8.1 Methodological approach for the energy calculation

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

- Only water collectors were used in the calculations (unglazed water collectors, flat-plate collectors and evacuated tube collectors). Air collectors were not included.
- For each country, the cumulated water collector area was allocated to the following applications (based on available country market data):
  - Solar thermal systems for swimming pool heating
  - Solar domestic hot water systems for single-family houses,
  - Solar domestic hot water systems for multifamily houses including the tourism sector as well as the public sector (to simplify the analysis solar district heating systems, solar process heat and solar cooling applications were also allocated here), and
  - Solar combi systems for domestic hot water and space heating for single- and multi-family houses.
- Reference systems were defined for each country and for each type of application (pumped or thermosiphon solar thermal system).
- The number of systems per country was determined from the share of collector area for each application and the collector area defined for the reference system.

Apart from the reference applications and systems mentioned above, reference collectors and reference climates were determined. On the basis of these boundary conditions, simulations were performed with the simulation program T-Sol [T-Sol, Version 4.5 Expert, Valentin Energiesoftware, www.valentin-software.com] and gross solar yields for each country and each system were obtained. The gross solar yields refer to the solar collector heat output and do not include heat losses through transmission piping or storage heat losses[23].

The amount of final energy saved is calculated from the gross solar yields considering a utilization rate of the auxiliary heating system of 0.8. Final energy savings are expressed in tons of oil equivalent (toe): 1 toe = 11,630 kWh.

Finally, the CO_2 emissions avoided by the different solar thermal applications are quoted as kilograms carbon dioxide equivalent ($kgCO_2e$) per tons of oil equivalent: 1 toe = 3.233 t CO_2e[24]

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

23 Using gross solar yields for the energy calculations is based on a definition for Renewable Heat by EUROSTAT and IEA SHC. In editions of this report prior to 2011 solar yields calculated included heat losses through transmission piping and hence energy savings considered were about 5 to 15% less depending on the system, the application and the climate.

24 Source: Defra /DECC 2013

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.

8.1.1 Reference systems for swimming pool heating

The information in **Table 6** refers to the total capacity of water collectors in operation used for swimming pool heating as reported from each country by the end of 2013.

Country*	Reference climate	Horizontal irradiation [kWh/m²·a]	Total collector area [m²]	Collector area per system [m²]	Total number of systems	Specific solar yield [kWh/m²·a]
Australia	Sydney	1,674	4,605,202	34	135,447	466
Austria	Graz	1,126	585,133	200	2,926	283
Barbados	Grantley Adams	2,016	9,218	200	46	544
Belgium	Brussels	971	34,145	200	171	262
Brazil	Brasília	1,793	2,940,434	200	14,702	375
Canada	Montreal	1,351	540,737	200	2,704	386
Croatia	Zagreb	1,212	10,190	200	51	327
Cyprus	Nicosia	1,886	1,690	200	8	508
Czech Republic	Praha	998	502,146	200	2,511	303
Denmark	Copenhagen	989	24,278	200	121	295
Estonia	Tallin	960	596	200	3	259
Finland	Helsinki	948	3,654	200	18	256
France	Paris	1,112	23,704	200	119	328
Germany	Würzburg	1,091	609,058	200	3,045	314
Hungary	Budapest	1,199	30,252	200	151	344
India	Neu-Delhi	1,961	124,624	200	623	529
Israel	Jerusalem	2,198	31,614	200	158	568
Italy	Bologna	1,419	184,645	200	923	442
Jordan	Amman	2,145	6,301	200	32	578
Latvia	Riga	991	423	200	2	267
Lithuania	Vilnius	1,001	574	200	3	270
Luxembourg	Luxembourg	1,037	3,206	200	16	280
Macedonia	Skopje	1,381	471	200	2	372
Malta	Luqa	1,902	3,391	200	17	513
Mauritius	Port Louis	1,920	8,058	200	40	518
Mexico	Mexico City	1,706	1,022,890	200	5,114	311
Morocco	Rabat	2,000	29,050	200	145	539
Mozambique	Maputo	1,910	29	200	0	515
Netherlands	Amsterdam	999	424,377	200	2,122	272
New Zealand	Wellington	1,401	11,175	200	56	378
Norway	Oslo	971	1,781	200	9	316
Portugal	Lisbon	1,686	1,809	200	9	421
Romania	Bucharest	1,324	8,999	200	45	357
Russia	Moscow	996	36	200	0	269
Slovakia	Bratislava	1,214	10,514	200	53	327
South Africa	Johannesburg	2,075	917,526	200	4,588	505
Spain	Madrid	1,644	159,767	200	799	472
Sweden	Gothenburg	934	129,844	200	649	295
Switzerland	Zürich	1,094	231,507	200	1,158	277
Taiwan	Taipei	1,372	12,365	200	62	319
Thailand	Bangkok	1,765	9,563	200	48	476
United Kingdom	London	943	52,071	200	260	254
United States	LA, Indianapolis	1,646	17,882,073	200	89,410	387
Uruguay	Montevideo	1,534	880	200	4	414
Zimbabwe	Harare	2,017	1,608	200	8	544
All other countries		1,455	1,652,846	200	8,264	392
	TOTAL		32,844,455		276,643	
	AVERAGE	1,434		119		392

* Countries not listed in this table did not report any share of collectors used for swimming pool heating.

Table 6: Solar thermal systems for swimming pool heating by end of 2013

Figure 44 shows the hydraulic scheme of the swimming pool reference system as used for the simulations of the solar energy yields.

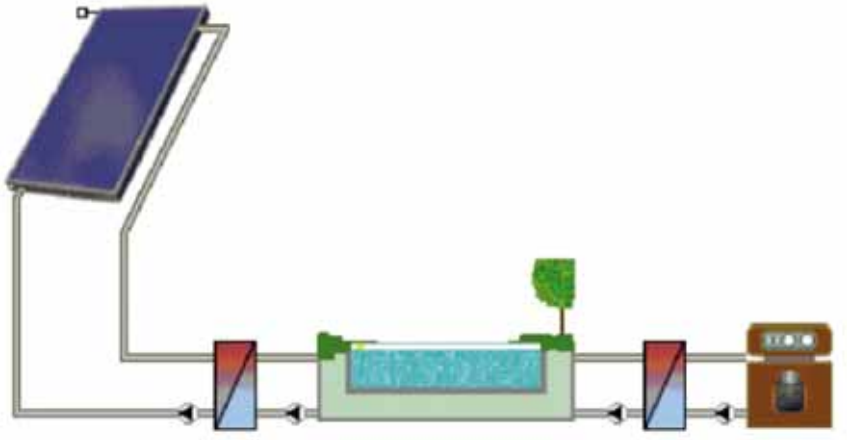


Figure 44: Hydraulic scheme of the swimming pool reference system

8.1.2 Reference systems for domestic hot water preparation in single-family houses

The information in **Table 7** refers to the total capacity of water collectors in operation used for domestic hot water heating in single family houses at the end of 2013 as reported by each country.

Country	Reference climate	Horizontal irradiation [kWh/m²·a]	Total collector area (DHW-SFH) [m²]	Collector area per system [m²]	Total number of systems	Specific solar yield (DHW-SFH) [kWh/m² ·a]	Type of system
Albania	Tirana	1,604	40,395	2.5	16,158	713	TS
Australia	Sydney	1,674	3,088,855	3.5	882,530	844	PS
Austria	Graz	1,126	2,148,847	6.0	358,141	451	PS
Barbados	Grantley Adams	2,016	105,352	4.0	26,338	882	TS
Belgium	Brussels	971	390,226	4.0	97,557	423	PDS/PS
Brazil	Brasília	1,793	6,092,273	4.0	1,523,068	809	TS
Bulgaria	Sofia	1,188	89,936	4.0	22,484	524	PS
Canada	Montreal	1,351	35,575	6.0	5,929	556	PS
Chile	Santiago de Chile	1,753	64,082	4.0	16,020	771	PS
China	Shanghai	1,282	337,194,000	4.0	84,298,500	592	TS
Croatia	Zagreb	1,212	116,452	4.0	29,113	539	PS
Cyprus	Nicosia	1,886	607,654	4.0	151,914	912	TS
Czech Republic	Praha	998	202,024	4.7	42,984	385	PS
Denmark	Copenhagen	989	331,068	4.0	82,767	454	PS
Estonia	Tallin	960	6,816	4.0	1,704	432	PS
Finland	Helsinki	948	41,762	4.0	10,440	441	PS
France	Paris	1,112	948,160	3.2	296,300	496	PS
Germany	Würzburg	1,091	7,607,303	6.0	1,267,884	424	PS
Greece	Athens	1,585	4,023,751	2.5	1,609,500	772	TS
Hungary	Budapest	1,199	151,260	6.0	25,210	473	PS
India	Neu-Delhi	1,961	4,361,840	4.0	1,090,460	882	TS
Ireland	Dublin	949	249,857	4.0	62,464	423	PS
Israel	Jerusalem	2,198	823,700	3.0	274,567	1,024	TS
Italy	Bologna	1,419	2,289,595	4.0	572,399	661	PS
Japan	Tokyo	1,175	3,935,866	4.0	983,967	586	TS
Jordan	Amman	2,145	948,776	4.6	206,256	986	TS
Korea, South	Seoul	1,161	951,788	4.0	237,947	525	PS
Latvia	Riga	991	4,832	4.0	1,208	462	PS
Lebanon	Beirut	1,935	213,180	4.0	53,295	860	TS
Lithuania	Vilnius	1,001	6,560	4.0	1,640	450	PS
Luxembourg	Luxembourg	1,037	36,640	4.0	9,160	450	PS
Macedonia	Skopje	1,381	41,946	4.0	10,486	627	PS
Malta	Luqa	1,902	38,758	4.0	9,690	868	PS
Mauritius	Port Louis	1,920	92,090	1.5	61,394	854	TS
Mexico	Mexico City	1,706	412,772	4.0	103,193	718	PS
Morocco	Rabat	2,000	332,000	4.0	83,000	889	TS
Mozambique	Maputo	1,910	332	4.0	83	849	TS
Namibia	Windhoek	2,363	9,903	4.0	2,476	1,032	TS
Netherlands	Amsterdam	999	350,886	2.8	125,316	433	PDS/PS
New Zealand	Wellington	1,401	127,716	4.0	31,929	647	PS
Norway	Oslo	971	1,227	8.0	153	430	PS
Palestinian Territ.		2,198	1,464,300	1.5	976,200	977	TS
Poland	Warsaw	1,024	1,039,500	6.0	173,250	397	PS
Portugal	Lisbon	1,686	664,902	4.0	166,226	804	PS
Romania	Bucharest	1,324	102,840	4.0	25,710	594	PS
Russia	Moscow	996	1,872	4.0	468	443	PS
Slovakia	Bratislava	1,214	120,160	6.0	20,027	481	PS
Slovenia	Ljubjana	1,115	155,044	6.0	25,841	424	PS
South Africa	Johannesburg	2,075	576,429	4.0	144,107	1,009	TS
Spain	Madrid	1,644	1,278,136	4.0	319,534	766	PS
Sweden	Gothenburg	934	34,504	4.0	8,626	383	PS
Switzerland	Zürich	1,094	772,800	5.7	135,579	426	PS
Taiwan	Taipei	1,372	1,451,345	4.8	302,363	616	TS
Thailand	Bangkok	1,765	109,289	4.0	27,322	854	TS
Tunisia	Tunis	1,808	690,840	2.8	246,728	902	TS
Turkey	Antalya	1,795	14,416,696	4.0	3,604,174	910	TS
United Kingdom	London	943	595,098	4.0	148,775	415	PS
United States	LA, Indianapolis	1,646	3,576,415	6.0	596,069	646	PS
Uruguay	Montevideo	1,534	10,057	4.0	2,514	682	TS
Zimbabwe	Harare	2,017	18,382	4.0	4,596	854	TS
All other countries		1,383	21,345,649	4.0	5,336,412	615	TS/PS
	TOTAL		426,940,313		106,950,145		
	AVERAGE	1,456		4.0		615	

DHW-SFH: domestic hot water systems for single-family houses
PS pumped system
TS thermosiphon system
PDS pumped drain back system

Table 7: Solar thermal systems for domestic hot water heating in single family houses by the end of 2013

Figure 45 shows the hydraulic scheme used for the energy calculation for all pumped solar thermal systems and **Figure 46** refers to the thermosiphon systems.

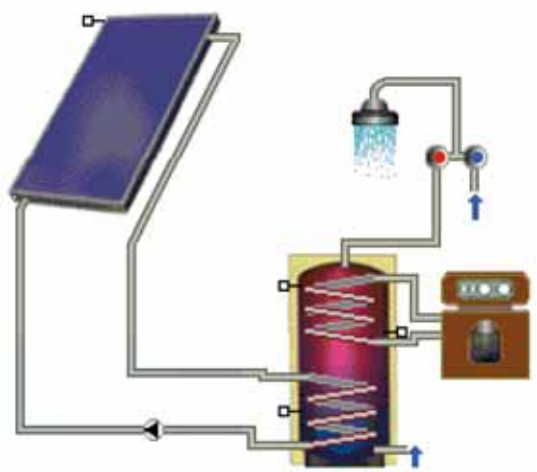


Figure 45: Hydraulic scheme of the domestic hot water pumped reference system for single family houses

Figure 46: Hydraulic scheme of the domestic hot water thermosiphon reference system for single family houses

For the Chinese thermosiphon systems the reference system above was used, but instead of a flat plate collector as shown in **Figure 46** a representative Chinese vacuum tube collector was used for the simulation.

8.1.3 Reference systems for domestic hot water preparation in multifamily houses

The information in **Table 8** refers to the total capacity of water collectors in operation used for domestic hot water heating in multifamily houses at the end of 2013 as reported by each country.

Country	Reference climate	Horizontal irradiation [kWh/m²·a]	Total collector area (DHW-MFH) [m²]	Collector area per system [m²]	Total number of systems	Specific solar yield (DHW-MFH) [kWh/m²·a]
Albania	Tirana	1,604	101,490	50.0	2,030	694
Australia	Sydney	1,674	328,943	50.0	6,579	725
Austria	Graz	1,126	400,787	50.0	8,016	505
Barbados	Grantley Adams	2,016	13,169	50.0	263	842
Belgium	Brussels	971	48,778	50.0	976	405
Brazil	Brasília	1,793	576,556	50.0	11,531	658
Bulgaria	Sofia	1,188	36,264	50.0	725	515
Canada	Montreal	1,351	313,058	50.0	6,261	621
Chile	Santiago de Chile	1,753	75,227	50.0	1,505	733
China	Shanghai	1,282	31,846,100	50.0	636,922	502
Croatia	Zagreb	1,212	14,557	50.0	291	506
Cyprus	Nicosia	1,886	80,415	50.0	1,608	750
Czech Republic	Praha	998	95,184	42.4	2,245	436
Denmark	Copenhagen	989	422,136	50.0	8,443	414
Estonia	Tallin	960	852	50.0	17	401
Finland	Helsinki	948	5,220	50.0	104	396
France	Paris	1,112	1,253,941	20.0	62,697	489
Germany	Würzburg	1,091	2,062,424	50.0	41,248	472
Greece	Athens	1,585	150,421	50.0	3,008	642
Hungary	Budapest	1,199	18,908	50.0	378	522
India	Neu-Delhi	1,961	1,744,736	50.0	34,895	749
Ireland	Dublin	949	8,329	50.0	167	425
Israel	Jerusalem	2,198	3,294,801	3.0	1,098,267	919
Italy	Bologna	1,419	664,721	50.0	13,294	593
Japan	Tokyo	1,175	4,074	50.0	81	516
Jordan	Amman	2,145	237,194	50.0	4,744	801
Korea, South	Seoul	1,161	810,782	50.0	16,216	458
Latvia	Riga	991	604	50.0	12	414
Lebanon	Beirut	1,935	347,820	50.0	6,956	809
Lithuania	Vilnius	1,001	820	50.0	16	418
Luxembourg	Luxembourg	1,037	4,580	50.0	92	433
Macedonia	Skopje	1,381	4,242	50.0	85	577
Malta	Luqa	1,902	4,845	50.0	97	794
Mauritius	Port Louis	1,920	11,511	50.0	230	801
Mexico	Mexico City	1,706	1,061,415	50.0	21,228	713
Morocco	Rabat	2,000	41,500	50.0	830	835
Mozambique	Maputo	1,910	42	50.0	1	797
Namibia	Windhoek	2,363	12,103	50.0	242	814
Netherlands	Amsterdam	999	82,295	50.0	1,646	418
New Zealand	Wellington	1,401	15,965	50.0	319	585
Norway	Oslo	971	16,305	50.0	326	406
Palestinian Territ.		2,198	162,700	50.0	3,254	917
Poland	Warsaw	1,024	371,250	50.0	7,425	447
Portugal	Lisbon	1,686	224,348	40.0	5,609	705
Romania	Bucharest	1,324	12,855	50.0	257	553
Russia	Moscow	996	15,649	50.0	313	416
Slovakia	Bratislava	1,214	15,020	50.0	300	507
Slovenia	Ljubjana	1,115	3,736	50.0	75	477
South Africa	Johannesburg	2,075	12,656	50.0	253	867
Spain	Madrid	1,644	1,501,809	50.0	30,036	676
Sweden	Gothenburg	934	45,854	50.0	917	430
Switzerland	Zürich	1,094	92,275	20.0	4,614	457
Taiwan	Taipei	1,372	81,918	33.8	2,424	518
Thailand	Bangkok	1,765	13,661	50.0	273	737
Tunisia	Tunis	1,808	15,540	50.0	311	756
Turkey	Antalya	1,795	1,253,626	50.0	25,073	750
United Kingdom	London	943	74,387	50.0	1,488	393
United States	LA, Indianapolis	1,646	2,384,276	50.0	47,686	688
Uruguay	Montevideo	1,534	1,257	50.0	25	640
Zimbabwe	Harare	2,017	2,298	50.0	46	842
All other countries		1,362	2,758,148	50.0	55,163	569
	TOTAL		55,256,376		2,180,133	
	AVERAGE	1,456		25.3		569

DHW-MFH: domestic hot water systems for multifamily houses
PS: pumped system

Table 8: Solar thermal systems for domestic hot water heating in multifamily houses by end of 2013

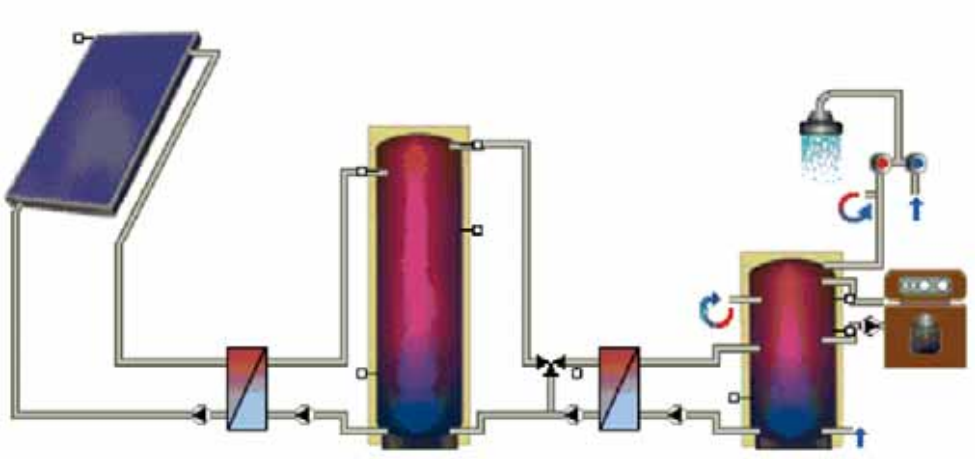


Figure 47: Hydraulic scheme of the domestic hot water pumped reference system for multifamily houses

Figure 47 shows the hydraulic scheme of domestic hot water reference system for multifamily houses as used for the simulations of the solar energy yields. As opposed to small-scale domestic hot water systems, all large-scale systems are assumed to be pumped solar thermal systems.

8.1.4 Reference systems for domestic hot water preparation and space heating in single and multifamily houses (solar combi-systems)

The information in **Table 9** refers to the total capacity of water collectors in operation used for domestic hot water heating in multifamily houses at the end of 2013 as reported by each country.

Country	Reference climate	Horizontal irradiation [kWh/m²·a]	Total collector area (Combi system) [m²]	Collector area per system [m²]	Total number of systems	Spec. solar yield (Combi system) [kWh/m²·a]
Austria	Graz	1,126	2,027,032	14.0	144,788	369
Barbados	Grantley Adams	2,016	3,951	12.0	329	709
Belgium	Brussels	971	14,633	12.0	1,219	342
China	Shanghai	1,282	5,619,900	12.0	468,325	388
Croatia	Zagreb	1,212	4,367	12.0	364	426
Cyprus	Nicosia	1,886	11,188	12.0	932	663
Czech Republic	Praha	998	171,915	8.4	20,466	351
Denmark	Copenhagen	989	7,608	12.0	634	348
Estonia	Tallin	960	256	12.0	21	338
Finland	Helsinki	948	1,566	12.0	131	334
France	Paris	1,112	144,594	11.0	13,145	370
Germany	Würzburg	1,091	7,235,390	12.0	602,949	378
Greece	Athens	1,585	4,178	12.0	348	558
Hungary	Budapest	1,199	51,681	15.0	3,445	422
Ireland	Dublin	949	19,433	12.0	1,619	364
Italy	Bologna	1,419	553,934	12.0	46,161	499
Japan	Tokyo	1,175	134,455	12.0	11,205	414
Latvia	Riga	991	181	12.0	15	349
Lithuania	Vilnius	1,001	246	12.0	21	352
Luxembourg	Luxembourg	1,037	1,374	12.0	115	365
Macedonia	Skopje	1,381	471	12.0	39	486
Malta	Luqa	1,902	1,453	12.0	121	669
Mauritius	Port Louis	1,920	3,453	12.0	288	676
Morocco	Rabat	2,000	12,450	12.0	1,038	704
Mozambique	Maputo	1,910	12	12.0	1	672
Netherlands	Amsterdam	999	22,892	6.0	3,815	352
New Zealand	Wellington	1,401	4,789	12.0	399	493
Norway	Oslo	971	20,263	20.0	1,013	342
Poland	Warsaw	1,024	74,250	12.0	6,188	365
Portugal	Lisbon	1,686	13,569	12.0	1,131	593
Romania	Bucharest	1,324	3,857	12.0	321	466
Russia	Moscow	996	656	15.0	44	350
Slovakia	Bratislava	1,214	4,506	12.0	376	427
Slovenia	Ljubjana	1,115	28,020	12.0	2,335	362
Spain	Madrid	1,644	255,627	10.0	25,563	619
Sweden	Gothenburg	934	243,798	10.0	24,380	389
Switzerland	Zürich	1,094	288,358	11.0	26,214	385
Thailand	Bangkok	1,765	4,098	12.0	342	621
United Kingdom	London	943	22,316	12.0	1,860	332
Uruguay	Montevideo	1,534	377	12.0	31	540
Zimbabwe	Harare	2,017	689	12.0	57	710
All other countries		1,105	890,636	12.0	74,220	389
	TOTAL		17,904,425		1,486,008	
	AVERAGE	1,305		12.0		389

Combi system: system for the supply of domestic hot water and space heating

Table 9: Solar combi system reference for single and multifamily houses and the total collector area in operation in 2013

Figure 48 shows the hydraulic scheme of domestic hot water reference system for multifamily houses as used for the simulations of the solar energy yields.

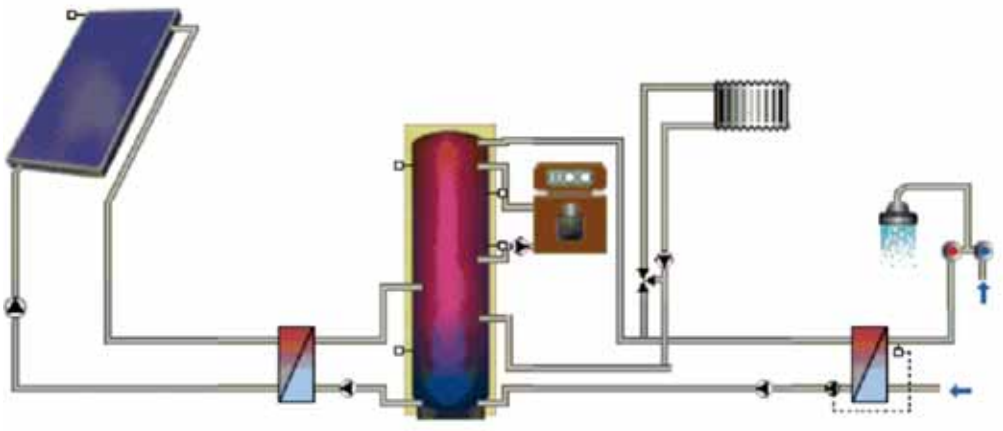


Figure 48: Hydraulic scheme of the solar-combi reference system for single and multifamily houses

8.2 Reference collectors

8.2.1 Data of the reference unglazed water collector for swimming pool heating

η = 0.85
a_1 = 20 [W/m²K]
a_2 = 0.1 [W/m² K²]

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

η = 0.8
a_1 = 3.69 [W/m²K]
a_2 = 0.007 [W/m² K²]

8.2.3 Data of the Chinese reference vacuum tube collector

η = 0.74
a_1 = 2.5 [W/m²K]
a_2 = 0.013 [W/m² K²]

8.3 Reference climates

No.	Country	Reference climate	Horizontal irradiation	Inclined irradiation	Avg. Outside air temp.
			[kWh/m²·a]	[kWh/m²·a]	[°C]
1	Albania	Tirana	1,604	1,835	13.5
2	Australia	Sydney	1,674	1,841	18.1
3	Austria	Graz	1,126	1,280	9.2
4	Barbados	Grantley Adams	2,016	2,048	27.4
5	Belgium	Brussels	971	1,095	10.0
6	Brazil	Brasília	1,793	1,838	22.0
7	Bulgaria	Sofia	1,188	1,304	10.1
8	Canada	Montreal	1,351	1,568	6.9
9	Chile	Santiago de Chile	1,753	1,850	14.5
10	China	Shanghai	1,282	1,343	17.1
11	Croatia	Zagreb	1,212	1,352	11.3
12	Cyprus	Nicosia	1,886	2,098	19.9
13	Czech Republic	Praha	998	1,111	7.9
14	Denmark	Copenhagen	989	1,164	8.1
15	Estonia	Tallinn	960	1,126	5.3
16	Finland	Helsinki	948	1,134	4.6
17	France	Paris	1,112	1,246	11.0
18	Germany	Würzburg	1,091	1,225	9.5
19	Greece	Athens	1,585	1,744	18.5
20	Hungary	Budapest	1,199	1,346	11.0
21	India	New-Delhi	1,961	2,275	24.7
22	Ireland	Dublin	949	1,091	9.5
23	Israel	Jerusalem	2,198	2,400	17.3
24	Italy	Bologna	1,419	1,592	14.3
25	Japan	Tokyo	1,175	1,287	16.7
26	Jordan	Amman	2,145	2,341	17.9
27	Korea, South	Seoul	1,161	1,280	12.7
28	Latvia	Riga	991	1,187	6.3
29	Lebanon	Beirut	1,935	2,132	19.9
30	Lithuania	Vilnius	1,001	1,161	6.2
31	Luxembourg	Luxembourg	1,037	1,158	8.4
32	Macedonia	Skopje	1,381	1,521	12.5
33	Malta	Luqa	1,902	2,115	18.7
34	Mauritius	Port Louis	1,920	2,010	23.3
35	Mexico	Mexico City	1,706	1,759	16.6
36	Morocco	Rabat	2,000	2,250	17.2
37	Mozambique	Maputo	1,910	2,100	22.8
38	Namibia	Windhoek	2,363	2,499	21.0
39	Netherlands	Amsterdam	999	1,131	10.0
40	New Zealand	Wellington	1,401	1,542	13.6
41	Norway	Oslo	971	1,208	5.8
42	Palestinian Territories	Jerusalem	2,198	2,400	17.3
43	Poland	Warsaw	1,024	1,156	8.1
44	Portugal	Lisbon	1,686	1,875	17.4
45	Romania	Bucharest	1,324	1,473	10.6
46	Russia	Moscow	996	1,181	5.9
47	Slovakia	Bratislava	1,214	1,374	10.3
48	Slovenia	Ljubjana	1,115	1,231	9.8
49	South Africa	Johannesburg	2,075	2,232	15.6
50	Spain	Madrid	1,644	1,844	15.5
51	Sweden	Gothenburg	934	1,105	7.2
52	Switzerland	Zürich	1,094	1,218	9.6
53	Taiwan	Taipei	1,372	1,398	20.8
54	Thailand	Bangkok	1,765	1,898	29.1
55	Tunisia	Tunis	1,808	2,038	19.3
56	Turkey	Antalya	1,795	1,958	18.4
57	United Kingdom	London	943	1,062	12.0
58	United States	LA, Indianapolis	1,646	1,816	14.3
59	Uruguay	Montevideo	1,534	1,647	15.9
60	Zimbabwe	Harare	2,017	2,087	18.9

Source: T-Sol expert version 4.5 and Meteonorm version 6.1.

Table 10: Reference climates for the 60 countries surveyed

8.4 Population data

No	Country	2013	Region code
1	Albania	3,011,405	6
2	Australia	22,262,501	3
3	Austria	8,221,646	6
4	Barbados	288,725	4
5	Belgium	10,444,268	6
6	Brazil	201,009,622	4
7	Bulgaria	6,981,642	6
8	Canada	34,568,211	8
9	Chile	17,216,945	4
10	China	1,349,585,838	5
11	Croatia	4,475,611	6
12	Cyprus	1,155,403	6
13	Czech Republic	10,609,762	6
14	Denmark	5,556,452	6
15	Estonia	1,266,375	6
16	Finland	5,266,114	6
17	France	65,951,611	6
18	Germany	81,147,265	6
19	Greece	10,772,967	6
20	Hungary	9,939,470	6
21	India	1,220,800,359	2
22	Ireland	4,775,982	6
23	Israel	7,707,042	7
24	Italy	61,482,297	6
25	Japan	127,253,075	2
26	Jordan	6,482,081	7
27	Korea, South	48,955,203	2
28	Latvia	2,178,443	6
29	Lebanon	4,131,583	7
30	Lithuania	3,515,858	6
31	Luxembourg	514,862	6
32	Macedonia	2,087,171	6
33	Malta	411,277	6
34	Mauritius	1,322,238	1
35	Mexico	118,818,228	4
36	Morocco	32,649,130	7
37	Mozambique	24,096,669	1
38	Namibia	2,182,852	1
39	Netherlands	16,805,037	6
40	New Zealand	4,365,113	3
41	Norway	5,085,582	6
42	Palestinian Territories	4,440,127	7
43	Poland	38,383,809	6
44	Portugal	10,799,270	6
45	Romania	21,790,479	6
46	Russia	142,500,482	6
47	Slovakia	5,488,339	6
48	Slovenia	1,992,690	6
49	South Africa	48,601,098	1
50	Spain	47,370,542	6
51	Sweden	9,647,386	6
52	Switzerland	7,996,026	6
53	Taiwan	23,299,716	2
54	Thailand	67,497,151	2
55	Tunisia	10,835,873	7
56	Turkey	80,694,485	6
57	United Kingdom	63,395,574	6
58	United States	316,438,601	8
59	Uruguay	3,324,460	4
60	Zimbabwe	13,182,908	1
	Other countries	2,635,464,300	9
	Σ Solar Thermal World Statistics	4,463,030,931	63.0%
	Σ Inhabitants world	7,098,495,231	100.0%

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

Table 11: Inhabitants by the end of 2013 of the 60 surveyed countries in alphabetical order

Region Code / Region		Σ Inhabitants	Share
1	Sub-Sahara Africa	89,385,765	1.3%
2	Asia excl. China	1,487,805,504	21.0%
3	Australia / New Zealand	26,627,614	0.4%
4	Latin America	340,657,980	4.8%
5	China	1,349,585,838	19.0%
6	Europe	751,715,582	10.6%
7	MENA Region	66,245,836	0.9%
8	United States / Canada	351,006,812	4.9%
9	Other countries	2,635,464,300	37.1%
TOTAL		7,098,495,231	100.0%

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

Sub-Sahara Africa: Mauritius, Mozambique, Namibia, South Africa, Zimbabwe
Asia excluding China: India, Japan, Korea South, Taiwan, Thailand
Latin America: Barbados, Brazil, Chile, Mexico, Uruguay
Europe: EU 28, Albania, Macedonia, Norway, Russia, Switzerland, Turkey
MENA Region: Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Table 12: Inhabitants per economic region by the end of 2013

8.5 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 as well.

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 officials 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}/m^2 to derive the nominal capacity from the area of installed collectors.

In order to ensure consistency of the calculations within this report the following tables provide data from the previous years. If necessary the numbers have been revised in 2013 compared to the data originally published in earlier editions of this report due to changes in methodology or the origin of the data for each country.

In the following **Table 13**, **Table 14** and **Table 15** these countries are highlighted accordingly and in Chapter 8.6 (References) the respective data source is cited.

Country	Water Collectors [m²]			Air Collectors [m²]		TOTAL [m²]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		12,890	98			12,988
Australia	600,000	343,980	22,230	36,000	900	1,003,110
Austria	5,700	221,500	8,690		350	236,240
Barbados**						
Belgium		35,500	10,000			45,500
Brazil	512,099	517,517				1,029,616
Bulgaria		10,000	800			10,800
Canada	74,490	7,880	9,500	28,377	7,165	127,412
Chile		19,037				19,037
China		2,880,000	54,720,000			57,600,000
Croatia*		14,587				14,587
Cyprus	142	26,794	1,643			28,579
Czech Republic	65,000	49,150	16,650			130,800
Denmark		61,897	504			62,401
Estonia		900	900			1,800
Finland		3,000	1,000			4,000
France (mainland)		242,200	8,800	553	117	251,670
Germany		1,152,000	118,000	428	0	1,270,428
Greece		230,000				230,000
Hungary	1,500	14,000	6,000	300	250	22,050
India*		381,600	572,400		1,200	955,200
Ireland		12,538	8,232			20,770
Israel	2,500	370,984				373,484
Italy		339,300	50,700			390,000
Japan		155,264	1,802		10,773	167,839
Jordan		54,531	13,705			68,236
Korea, South		54,733				54,733
Latvia		1,000	800			1,800
Lebanon		40,000	20,000			60,000
Lithuania		600	1,200			1,800
Luxembourg		3,500	1,000			4,500
Macedonia*		5,120	453			5,573
Malta		2,335	480			2,815
Mauritius #						
Mexico	90,000	95,000	85,000	300		270,300
Morocco*		36,000				36,000
Mozambique			130			130
Namibia**						
Netherlands	27,396	31,445	5,000			63,841
New Zealand**						
Norway	160	2,863	946			3,969
Palestinian Territ. #						
Poland		187,400	66,300			253,700
Portugal	235	126,227	736	204		127,402
Romania		8,500	7,000			15,500
Russia						
Slovakia		19,320	3,680			23,000
Slovenia		9,000	3,000			12,000
South Africa	48,200	42,811	39,300			130,311
Spain	8,600	249,700	17,250	1,500		277,050
Sweden	22,601	15,654	5,153			43,408
Switzerland	9,040	129,142	8,721	9,000		155,903
Taiwan		100,386	11,061			111,447
Thailand		18,900				18,900
Tunisia		64,300	8,000			72,300
Turkey		1,301,075	504,600	1,570		1,807,245
United Kingdom		72,953	18,826	5,597		97,376
United States	747,900	220,000	11,400	15,500	6,000	1,000,800
Uruguay**						
Zimbabwe		230	320			550
All other countries #	116,609	526,065	2,968,000	5,228	1,408	3,617,310
TOTAL	2,332,172	10,521,308	59,360,010	104,557	28,163	72,346,209

* revised due to new / adapted database in 2015

** no data for new installations in the respective year available

Table 13: Newly installed collector area in 2011 (revised 2015) [m²]

Country	Water Collectors [m²]			Air Collectors [m²]		TOTAL [m²]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		21,060	140			21,200
Australia	650,000	239,400	30,450	35,000	1,000	955,850
Austria	2,410	200,800	5,590		830	209,630
Barbados**						
Belgium		50,500	11,500			62,000
Brazil	525,508	625,855				1,151,363
Bulgaria		7,400	600			8,000
Canada	71,510	6,513	7,812	15,824	12,359	114,018
Chile*		20,000				20,000
China*		4,850,000	57,150,000			62,000,000
Croatia*		18,474				18,474
Cyprus	24	20,646	1,439			22,109
Czech Republic	50,000	37,000	13,000			100,000
Denmark		112,500	500			113,000
Estonia		900	900			1,800
Finland		3,000	1,000			4,000
France (main-land)		240,750	8,750	4,500	1,000	255,000
Germany		1,036,000	114,000			1,150,000
Greece		241,500	1,500			243,000
Hungary	1,500	35,000	15,000	300	250	52,050
India*		429,000	1,001,000		2,500	1,432,500
Ireland		18,516	8,148			26,664
Israel	1,200	310,500				311,700
Italy		283,800	46,200			330,000
Japan		158,741	3,208		7,950	169,899
Jordan		54,531	13,705			68,236
Korea, South		63,774				63,774
Latvia		150	150			300
Lebanon*		34,000	10,000			44,000
Lithuania		600	1,200			1,800
Luxembourg		3,250	900			4,150
Macedonia*		5,120	453			5,573
Malta		1,499	510			2,009
Mauritius #		43,470				43,470
Mexico	109,500	95,250	95,250			300,000
Morocco*		36,000				36,000
Mozambique			143			143
Namibia**						
Netherlands	27,396	27,972	8,000			63,368
New Zealand**						
Norway		15,236	795		1,983	18,014
Palestin. Territ. #		115,000	7,000			122,000
Poland		216,000	86,000			302,000
Portugal	182	83,624	7,090			90,896
Romania		8,500	7,000			15,500
Russia		6,097	287			6,384
Slovakia		6,500	1,000			7,500
Slovenia		13,500	3,000			16,500
South Africa	49,068	22,176	50,344			121,588
Spain	3,591	211,060	12,623			227,274
Sweden	910	8,251	3,006			12,167
Switzerland	11,815	125,609	17,287			154,711
Taiwan	5	105,698	11,848			117,551
Thailand		22,660				22,660
Tunisia		74,238	2,180			76,418
Turkey		1,146,298	478,000			1,624,298
United Kingdom		47,893	11,382	5,000		64,275
United States	757,400	229,700	12,000	15,000	14,000	1,028,100
Uruguay**						
Zimbabwe		802	570			1,372
Other countries (5%) #	119,054	620,648	3,119,077	3,980	2,204	3,864,963
TOTAL	2,381,073	12,412,961	62,381,537	79,604	44,076	77,299,251

* revised due to new / adapted database in 2015

** no data for new installations in the respective year available

\# added in 2015

Table 14: Newly installed collector area in 2012 (revised 2015) [m²]

Country	Water Collectors [m²]			Air Collectors [m²]		TOTAL [m²]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		111,135	786			111,921
Australia	4,350,000	2,908,000	68,000	280,000	7,200	7,613,200
Austria	558,601	4,289,605	79,542		1,908	4,929,656
Barbados**		131,690				131,690
Belgium	45,000	329,469	55,064			429,533
Brazil	2,314,735	5,947,321				8,262,056
Bulgaria		120,050	2,050			122,100
Canada	778,102	61,475	35,695	349,750	24,140	1,249,162
Chile		80,009				80,009
China*		22,707,614	300,392,386			323,100,000
Croatia		120,000				120,000
Cyprus*	2,147	684,681	23,095			709,923
Czech Republic	468,000	335,813	87,925			891,738
Denmark	20,515	634,310	8,584	3,264	18,000	684,673
Estonia		3,930	2,590			6,520
Finland	11,779	30,251	6,472			48,502
France (mainland)*	105,699	2,032,271	42,129	5,053	1,117	2,186,269
Germany*	585,600	14,257,000	1,802,000		30,720	16,675,320
Greece		4,104,200	17,800			4,122,000
Hungary	13,500	168,700	51,100	1,800	1,450	236,550
India*		2,923,010	2,208,190		4,200	5,135,400
Ireland		184,524	87,444			271,968
Israel*	31,817	4,144,576	422	550		4,177,365
Italy	43,766	2,926,580	476,420			3,446,766
Japan		4,378,220	83,340		502,949	4,964,509
Jordan	5,940	873,420	244,674			1,124,034
Korea, South		1,684,824				1,684,824
Latvia		2,850	1,190			4,040
Lebanon		234,000	292,000			526,000
Lithuania		3,300	2,700			6,000
Luxembourg		35,050	4,750			39,800
Macedonia		35,260	1,630			36,890
Malta		37,650	9,413			47,063
Mauritius #		106,233				106,233
Mexico	756,703	856,757	613,617	352	8,373	2,235,802
Morocco		379,000				379,000
Mozambique			273			273
Namibia**		20,699	1,307			22,006
Netherlands	418,783	428,859	17,000			864,642
New Zealand**	7,025	142,975	9,644			159,645
Norway	2,007	31,445	2,674		2,961	39,088
Palestinian Territ. #		1,505,000	0			1,505,000
Poland		916,500	295,000			1,211,500
Portugal	2,128	834,777	22,090			858,995
Romania		80,700	30,000			110,700
Russia		17,601	1,297			18,898
Slovakia		125,920	21,080			147,000
Slovenia		167,550	19,250			186,800
South Africa	866,871	381,044	115,597			1,363,512
Spain	134,191	2,661,260	167,373			2,962,824
Sweden	130,000	260,000	60,000			450,000
Switzerland	211,540	980,970	72,980	876,000		2,141,490
Taiwan	2,254	1,324,383	107,546			1,434,183
Thailand		120,360				120,360
Tunisia		593,038	46,180			639,218
Turkey		12,763,258	1,811,970	1,570		14,576,798
United Kingdom		537,990	171,683	19,000		728,673
United States	20,444,848	2,647,521	117,232	95,239	20,000	23,324,841
Uruguay**		12,571				12,571
Zimbabwe		18,761	807			19,568
All other countries #	1,700,608	5,496,630	16,304,842	85,925	32,790	23,620,795
TOTAL 2010	34,012,159	109,932,591	326,096,834	1,718,504	655,809	472,415,896

* revised due to new / adapted database in 2015

** no data for new installations in the respective year available

\# added in 2015

Table 15: Total collector area in operation by the end of 2012 (revised 2015) [m²]

8.6 References to reports and persons that have supplied the data

The production of the report, *Solar Heat Worldwide 2013 – Edition 2015 edition* was kindly supported by national representatives of the recorded countries or other official sources of information as cited below.

COUNTRY	CONTACT	SOURCE REMARKS
Albania	**Dr. Eng. Edmond M. HIDO** EEC - Albania-EU Energy Efficiency Centre (EEC)	EEC - Albania-EU Energy Efficiency Centre
Australia	**Dr. David Ferrari** Sustainability Victoria	Sustainability Victoria Out of operation systems calculated by Sustainability Victoria
Austria	**Werner Weiss** AEE - Institute for Sustainable Technologies	Biermayr et al, 2014: Innovative energy technologies in Austria - Market Development 2013 Out of operation systems calculated by AEE INTEC
Barbados		No data available since 2009, Cumulated area by end of 2009
Belgium	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
	AEE INTEC	Unglazed water collectors: AEE INTEC recordings
Brazil	**Marcelo Mesquita** Depto. Nac. de Aquecimento Solar da ABRAVA	DASOL ABRAVA Out of operation systems calculated based on DASOL ABRAVA long time recordings
Bulgaria	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
	AEE INTEC	Unglazed water collectors: AEE INTEC recordings
Canada	**Reda Djebbar, Ph.D., P.Eng.** Natural Resources Canada	Clear Sky Advisors, April 2015 Report - „Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2013/2014)" Out of operation systems considered by NRC
Chile	**AEE INTEC**	AEE INTEC, 2015 (estimation) Cumulated installations by end of 2013 based on estimation for new installations in 2012 and 2013
China	**Hu Runqing** Center for Renewable Energy Development - Energy Research Institute (NDRC)	CSTIF - Chinese Solar Thermal Industry Federation Out of operation systems calculated by CSTIF – new methodology considered
Croatia	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
Cyprus	**Soteris Kalogirou, PhD, DSc** Cyprus University of Technology	Cyprus Institue of Energy provided New installations: Cyprus Institute of Energy
	ESTIF – European Solar Thermal Industry Federation	Cumulated installations: ESTIF 2014 / share FPC-ETC + unglazed: CYPRUS INTSTITUTE OF ENERGY
Czech Republic	**Ales Bufka** Ministry of Industry and Trade	Ministry of Industry and Trade
Denmark	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
	AEE INTEC	Unglazed water collectors: AEE INTEC recordings

Estonia	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014 (estimation)
Finland	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014 (estimation)
	AEE INTEC	Unglazed water collectors: AEE INTEC recordings
France (mainland)	**Céline Coulaud** ADEME - Centre de Sophia Antipolis	Glazed water collectors: ADEME; Enerplan New installations: Uniclima/Enerplan/ADEME - provided by Celine Coulaud
	John Hollick SAHWIA - Solar Air Heating World Industry Association	Air collectors: SAHWIA Air collectors data provided by John Hollick
	ESTIF – European Solar Thermal Industry Federation	Unglazed water collectors: AEE INTEC recordings Cumulated installations: ESTIF 2014 / share FPC-ETC: AEE INTEC / unglazed water collectors: AEE INTEC
Germany	**Jan Knaack** BSW - Bundesverband Solarwirtschaft e.V.	Glazed water collectors: BSW-Solar New installations: water collectors: BSW-Solar; ESTIF 2014
	John Hollick SAHWIA - Solar Air Heating World Industry Association	Unglazed water collectors: AEE INTEC recordings Air collectors: SAHWIA Cumulated installations: water collectors: calculated by AEE INTEC based on BSW-Solar long-time recordings, 20 years life-time considered; air collectors: AEE INTEC recordings
Greece	**Vassiliki Drosou, M.Sc. PhD** CRES - Centre for Renewable Energy Sources	Vassiliki Drosou (CRES), Costas Travasoras (EBHE) New installations: ETC/FPC by ESTIF; Vassiliki DROSOU (CRES), Costas TRAVASAROS (EBHE)
	AEE INTEC	Cumulated installations: cumulated area: ESTIF 2014 / share FPC-ETC: AEE INTEC
Hungary	**Pál Varga** MÉGNAP- Hungarian Solar Thermal Industry Federation	MÉGNAP- Hungarian Solar Thermal Industry Federation New and cumulated installations: Hungarian Solar Thermal Industry Federation (MÉGNAP).; provided by Pál Varga (personal estimation)
India	**Jaideep N. Malaviya** Malaviya Solar Energy Consultancy	Malaviya Solar Energy Consultancy (based on market survey) New and cumulated installations based on survey from Malaviya Solar Energy Consultancy; out of operation systems considered!
Ireland	**Mary Holland** Sustainable Energy Authority of Ireland	Energy policy statistical support unit of Sustainable Energy Authority of Ireland Grant scheme data; BER database: Source: Energy policy statistical support unit of Sustainable Energy Authority of Ireland; provided by Mary Holland
Israel	**Dr. Asher Vaturi** ICTAF - Israel Bureau of Statistics	Israel Bureau of Statistics, Israel Ministry of water and energy & The Max Stern Yezreel Valley College (Dr. Asher Vaturi) Out of operation systems (replacements) considered by ICTAF
Italy	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
	AEE INTEC	Unglazed water collectors: AEE INTEC recordings
Japan	**Yamashita Noriaki** ISEP - Institute for Sustainable Energy Policies	ISEP; Solar System Development Association (SSDA) Out of operation systems calculated by ISEP

Jordan	**AEE INTEC**	AEE INTEC, 2015 (estimation) New installations: projected by AEE INTEC (0% growth rate 2012 / 2013) Cumulated installations: calculated by AEE INTEC based on estimation for new installations in 2013
Korea, South	**Eunhee Jeong** Korea Energy Management Corporation (KEMCO)	2013 New & Renewable Energy Statistics by the Korea New & Renewable Energy Center, 2014
Latvia	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014 (estimation)
Lebanon	**Tony Matar** The Lebanese Association for Energy Saving & for Environment (ALMEE)	The Lebanese Association for Energy Saving & for Environment (ALMEE) Out of operation systems considered by ALMEE
Lithuania	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014 (estimation)
Luxembourg	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014 (estimation)
Macedonia	**Prof. Dr. Ilja Nasov** National University St.Kiril and Metodij, Faculty for Natural Science, Institute of Physics, Solar Energy Department	New installations: estimation of Ilya Nasov and other solar experts New installations: estimation of Ilya Nasov and other solar experts; cumulated installations: calculated by AEE INTEC based on new installation figures
Malta	**Godwin Sant** Malta Resources Authority	Sustainable Energy and Water Conservation Unit (SEWCU) based on data provided by the Malta Resources Authority
Mauritius	**Devika Balgobin** Statistician / Environment Statistics Unit Ministry of Environment and Sustainable Development	Statistics Mauritius New and cumulated installations 2013 - provided by Devika Balgobin - Statistics Mauritius
Mexico	**Information provided by Bärbel Epp** Solrico – Solar market research http://www.solrico.com/	Glazed and unglazed water collectors: FAMERAC - Renewable Energy Industry Association Air collectors: SAHWIA - Solar Air Heating World Industry Association New installations: Water collectors: FAMERAC; air collector data: SAHWIA Cumulated installations: calculated by AEE INTEC based on data from ANES and solarthermalworld.org
Morocco	**Ashraf Kraidy** RECREEE - Regional Center for Renewable Energy and Energy Efficiency	ADEREE - L'Agence Nationale pour le Développement des Energies New installations (water collectors): ADEREE; provided by Ashraf Kraidy (new installations 2012 and 2011 estimated by AEE INTEC)
Mozambique	**AEE INTEC**	AEE INTEC, 2015 (estimation) Cumulated installations by end of 2013 based on estimation for new installations in 2012 and 2013
Namibia		No data available since 2011. Cumulated area by end of 2012
Netherlands	**Reinoud Segers** Statistics Netherlands (CBS)	Statistics Netherlands (CBS) Cumulated areas: Statistics Netherlands based on survey of sales. Market Shares: Expert estimates Netherlands Enterprise Agency and Holland Solar.
New Zealand		No data available since 2010. Cumulated area by end of 2009

Norway	**Peter Bernhard** Asplan Viak AS – KanEnergi	Asplan Viak AS – KanEnergi (Peter Bernhard) and Norwegian Solar Energy Society (Åse Lekang Sørensen)
Palestinian Territories	**Ashraf Kraidy** RECREEE - Regional Center for Renewable Energy and Energy Efficiency	Palestinian Central Bureau of Statistics, Palestinian Energy & Environment Research Center
Poland	**Aneta Więcka / Grzegorz Wiśniewski** Institute for Renewable Energy (EC BREC IEO)	EC BREC IEO 2014: Polish solar thermal energy market'2014
Portugal	**APISOLAR - Associação Portuguesa da Indústria Solar**	APISOLAR (www.apisolar.pt) „Observatório Solar Térmico 2013" New installations: APISOLAR + unglazed: APISOLAR (www.apisolar.pt) [Observatório Solar Térmico 2013]
	ESTIF – European Solar Thermal Industry Federation	ESTIF 2014 Cumulated installations: ESTIF 2014 / share FPC-ETC
Romania	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
Russia	**Dr. Semen Frid, Dr. Sophia Kiseleva** Moscow State University Prof. Vitaly Butuzov Yuzhgeoteplo corporation, Krasnodar	Joint Institute for High Temperatures of Russian Academy of Scienses (JIHT RAS) Dr. Semen Frid, Sophia Kiseleva - Moscow State University, Vitaly Butuzov - Energytechnologies Ltd. (Krasnodar); the source of information - JIHT RAS.
Slovakia	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
Slovenia	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
South Africa	**Prof. Dieter Holm** SOLTRAIN coordinator Southern Africa and SESSA organizer for Gauteng	DoE, Eskom, GIZ, Deloitte & Touche, CRSES, municipalities, SESSA
Spain	**Pascual Polo** ASIT - Asociación Solar de la Industria Térmica	ASIT (Solar Energy Industry Association of Spain) Out of operation systems calculated by ASIT
Sweden	**Prof. Jan-Olof Dalenbäck** Svensk Solenergi / CHALMERS	Svensk solenergi (Solar Energy Association of Sweden)
Switzerland	**http://www.swissolar.ch/**	SWISSOLAR 2014 - Markterhebung Sonnenenergie 2013 [report] Out of operation systems calculated by SWISSOLAR Replacements for "hay drying applications" estimated by AEE INTEC
Taiwan	**K.M. Chung** Energy Research Center - National Cheng Kung University	Bureau of Energy, Ministry of Economic Affairs, R.O.C. Out of operation systems calculated by Bureau of Energy, Ministry of Economic Affairs, R.O.C.
Thailand	**Information provided by Bärbel Epp** Solrico – Solar market research http://www.solrico.com/	Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy Thailand New installations: DEDE (Link) Cumulated installations: calculations AEE INTEC based on publication from GIZ (Link to presentation)
Tunisia	**Abdelkader Baccouche** Agence Nationale pour la Maîtrise de l'Energie (ANME)	ANME (National Agency of Energy Conservation)

Turkey	**A. Kutay Ulke** EZINC Metal San. Tic. A.S.	Water collectors: Ezinc Metal San. Tic. A.S. New installations: Ezinc Metal San. Tic. A.S cumulated installations: calculated by AEE INTEC considering replacements
	John Hollick SAHWIA - Solar Air Heating World Industry Association	Air collectors: SAHWIA
United Kingdom	**ESTIF – European Solar Thermal Industry Federation**	Glazed water collectors: ESTIF, 2014
United States	**Les Nelson** **IAPMO Solar Heating & Cooling Programs**	Water Collectors and air collectors: IAPMO Solar Heating & Cooling Programs; Out of operation systems considered based on historical data (1975 – 2009) from U.S. Department of Energy (DoE) - Energy Information Administration (EIA)
	John Hollick SAHWIA - Solar Air Heating World Industry Association	Air collectors: SAHWIA
Uruguay		No data available since 2010. Cumulated area by end of 2011
Zimbabwe	**Anton Schwarzlmüller**	SOLTRAIN survey (unpublished sources)

8.6.1 Additional literature and web sources used

The following reports and statistics were used in this report:

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- Bundesministerium für Verkehr, Innovation und Technologie (BMVIT): Innovative energy technologies in Austria - Market Development 2013; prepared by Peter Biermayr et al., Vienna, Austria May 2014
- Bundesverband Solarwirtschaft e.V. (BSW-Solar): Statistische Zahlen der deutschen Solarwärmebranche (Solarthermie) 2014; accessed on April 2015
- ClearSky Advisors Inc.: Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2013/2014); Prepared by ClearSky Advisors Inc., Dr. Reda Djebbar, Natural Resources Canada, March 2015
- European Solar Thermal Industry Federation (ESTIF): Solar Thermal Markets in Europe, Trends and Market Statistics 2013; Belgium - Brussels; June 2014

The following online sources were used in this report:

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- http://www.aderee.ma/
- http://www.apisolar.pt/
- http://www.asit-solar.com/
- http://www.dasolabrava.org.br/
- http://www.epia.org/home/
- http://www.estif.org/
- http://www.giz.de/
- http://www.iea-shc.org/
- http://www.irena.org/
- http://www.mnre.gov.in/
- http://www.ome.org/
- http://www.olade.org/
- www.ren21.net/
- http://sahwia.org/
- http://www.solar-district-heating.eu/
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- http://www.solrico.com/
- http://www.solarthermalworld.org/
- http://www.swissolar.ch/

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