WERNER WEISS | FRANZ MAUTHNER

SOLAR HEAT WORLDWIDE

Markets and Contribution to the Energy Supply 2010

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

2012
EDITION

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Cover: World's largest solar thermal plant at Princess Noura Bint Abdulrahman University for Women in Riyadh, Saudi Arabia (Photo: Millenium Energy Industry)

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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 questionnaire survey of the national delegates of the SHC Programme's Executive Committee and other national experts active in the field of solar thermal energy. As some of the 55 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 55 countries included in this report represent 4.2 billion people, which is about 61% of the world's population. The installed capacity in these countries is estimated to represent over 90% of the solar thermal market worldwide.

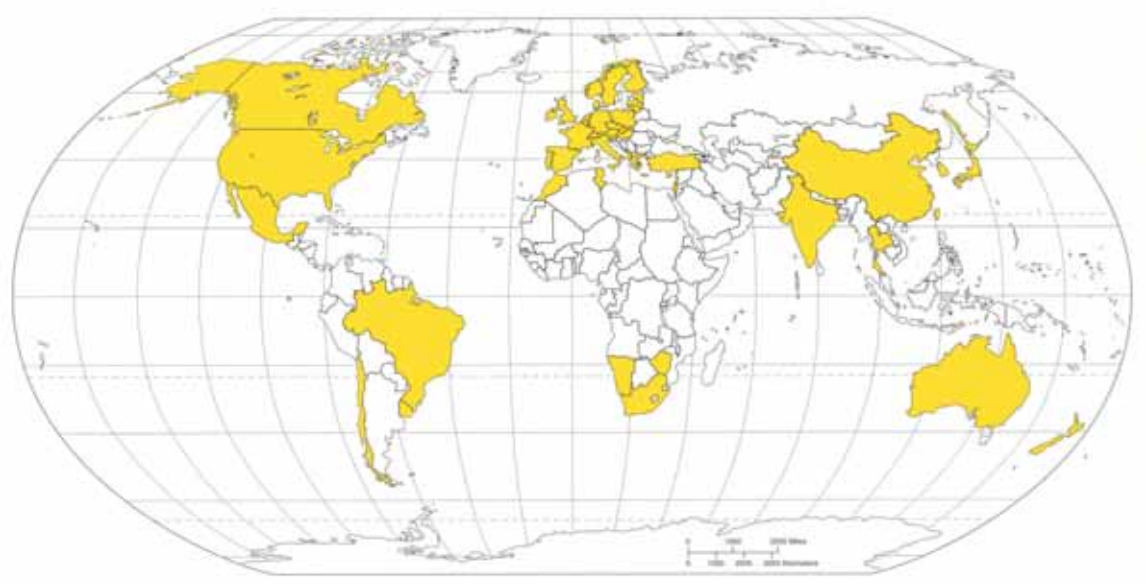


Figure 1: Countries represented in this report

2 Summary

Total installed capacity in operation worldwide by the end of 2010

By the end of 2010, an installed capacity of 195.8 GW_{th} corresponding to a total of 279.7 million square meters[1] of collector area was in operation in the 55 countries recorded in this report. These 55 countries represent 4.2 billion people, which is 61% of the world's population. The installed capacity in these countries represents more than 95% of the solar thermal market worldwide.

The vast majority of the total 2010 capacity was installed in China (117.6 GW_{th}) and Europe (36.0 GW_{th}), which together accounted for 78.5% of the total installed. The remaining installed capacity was shared between the United States and Canada (16.0 GW_{th}), Asia, excluding China (9.4 GW_{th}), Australia and New Zealand (6.0 GW_{th}), Central and South America (5.5 GW_{th}), the MENA[2] countries Israel, Jordan, Lebanon, Morocco and Tunisia (4.4 GW_{th}) as well as between some Sub-Saharan African countries (0.8 GW_{th}), namely Namibia, South Africa and Zimbabwe.

The leading countries in cumulated water collector capacity in operation in 2010 per 1,000 inhabitants were Cyprus (577 kW_{th}/1,000 inhabitants); Israel (397 kW_{th}/1,000 inhabitants); Austria (388 kW_{th}/1,000 inhabitants); Barbados (323 kW_{th}/1,000 inhabitants), Australia (271 kW_{th}/1,000 inhabitants), Greece (266 kW_{th}/1,000 inhabitants), Turkey (120 kW_{th}/1,000 inhabitants), Germany (118 kW_{th}/1,000 inhabitants), Jordan (109 kW_{th}/1,000 inhabitants) and Switzerland (93 kW_{th}/1,000 inhabitants).

The breakdown of the cumulated capacity in operation in 2010 by collector type is 31.7% glazed flat-plate collectors, 56.6% evacuated tube collectors, 11.0% unglazed water collectors and 0.7% glazed and unglazed air collectors.

Newly installed capacity worldwide in 2010

In the year 2010, a total capacity of 42.2 GW_{th} corresponding to 60.2 million square meters of solar collectors were installed worldwide. This means an increase in new collector installations of 13.9% compared to the year 2009.

The main markets were in China (34.30 GW_{th}) and Europe (3.93 GW_{th}), which together accounted for 94.7% of the overall new collector installations in 2010. The rest of the market was shared between the United States and Canada (0.95 GW_{th}), Asia, excluding China, (0.88 GW_{th}), Central and South America (0.87 GW_{th}), Australia (0.76 GW_{th}), the MENA region represented by Israel, Jordan, Lebanon, Morocco and Tunisia (0.40 GW_{th}) and the Sub-Saharan African countries Namibia, South Africa and Zimbabwe (0.08 GW_{th}).

The leading countries in newly installed water collector capacity in 2010 per 1,000 inhabitants were Australia (35 kW_{th}/1,000 inhabitants); Israel (30 kW_{th}/1,000 inhabitants); China (26 kW_{th}/1,000 inhabitants); Austria (24 kW_{th}/1,000 inhabitants), Cyprus (22 kW_{th}/1,000 inhabitants), Turkey (15 kW_{th}/1,000 inhabitants), Switzerland (14 kW_{th}/1,000 inhabitants), Greece (14 kW_{th}/1,000 inhabitants), Portugal (12 kW_{th}/1,000 inhabitants) and Jordan (11 kW_{th}/1,000 inhabitants).

The breakdown of the newly installed capacity in 2010 by collector type is 17.9% glazed flat-plate collectors, 77.8% evacuated tube collectors, 4.1% unglazed water collectors and 0.2% glazed and unglazed air collectors.

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}/m2 to derive the nominal capacity from the area of installed collectors.

2 Middle East and North Africa

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 2010 in the 55 recorded countries was 162,125 GWh (= 583,649 TJ). This corresponds to energy savings equivalent to 17.3 million tons of oil and 53.1 million tons of CO_2.

Distribution of systems by system type and application

The thermal utilization of the energy from the sun varies greatly in different regions on Earth. It can be roughly distinguished by the type of solar thermal collector used, the way of system operation (pumped solar thermal system or thermosiphon systems) and the main application the energy gained from the sun is used for (hot water preparation, space heating, industrial processes, cooling).

In China vacuum tube collectors play an important role and since China is by far the largest market with high growth rates the worldwide figures tend towards a higher share of this type of solar thermal collector as well. Unglazed water collectors account for 11% of the cumulated water collectors installed worldwide and tends to decrease.

Worldwide about three quarters of all solar thermal systems installed are operated by means of the thermosiphon principle and the rest are pumped solar heating systems. Similar to the distribution by type of solar thermal collector, the Chinese market influences the overall figures most and in 2010 89% of the newly installed systems were estimated to be thermosiphon systems while pumped system only accounted for 11%.

The calculated number of different types of solar thermal systems in operation exceeded 53 million by the end of 2010. Hereof, an estimated 85% were used for domestic hot water preparation in single family houses and 10% were attached to larger domestic hot water consumers such as multifamily houses, hotels, hospitals, schools, homes for elderly people, etc. The remaining 5% of the worldwide installed capacity supplied heat for both domestic hot water and space heating (solar combi systems) and for other applications, such as solar supported district heating networks, industrial processes and solar air conditioning applications.

By contrast, for newly installed systems the trend was towards more sophisticated applications with a worldwide share of 10% for solar combi systems and other applications than domestic hot water preparation. In several well-established markets in Europe (e.g., Germany, Spain, Austria, Switzerland and France) solar domestic hot water preparation accounted for less than half of the total market in 2010 whereas the market penetration of solar combi systems, solar supported district heating networks, industrial applications and solar air conditioning systems increased.

Employment

Based on data collected from detailed country reports, the number of jobs in the fields of production, installation and maintenance of solar thermal systems is estimated to be 375,000 worldwide in 2011.

Preview 2011

The estimated total capacity of solar thermal collectors in operation worldwide by the end of 2010 is 245 GW_{th} respectively 350 million square meters of collector area.

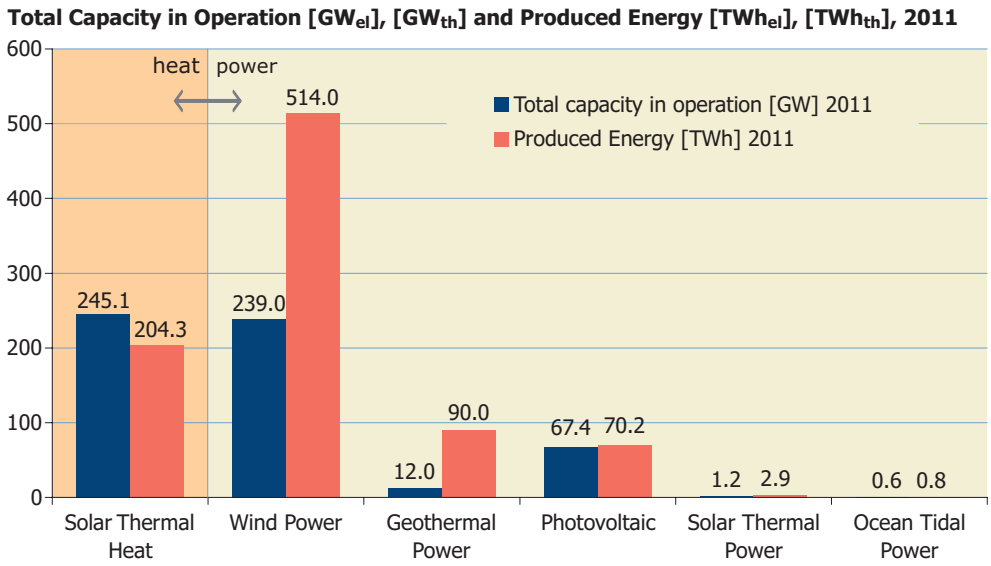


Figure 2: Total capacity in operation [GW_{el}], [GW_{th}] 2011 and annual energy generated [TWh_{el}], [TWh_{th}].
Sources: EPIA, EGEC, Earth Policy Institute, IEA SHC 2011, WWEA

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.

In 2011, the cumulated wind power capacity installed was almost as high as the total installed solar thermal capacity in operation, whereas, in the year 2005 the installed wind power capacity was half compared to solar thermal. Another growing market in 2011 was photovoltaics. In 2005 peak photovoltaic power installed was about 1/30 of the total solar thermal capacity installed; in 2011 photovoltaic was heading towards 1/3.

3 Total capacity in operation by end of 2010

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 base were used or, if such reports were not available, a 25-year lifetime for a system was calculated. The collector area in operation was then calculated using a linear equation.

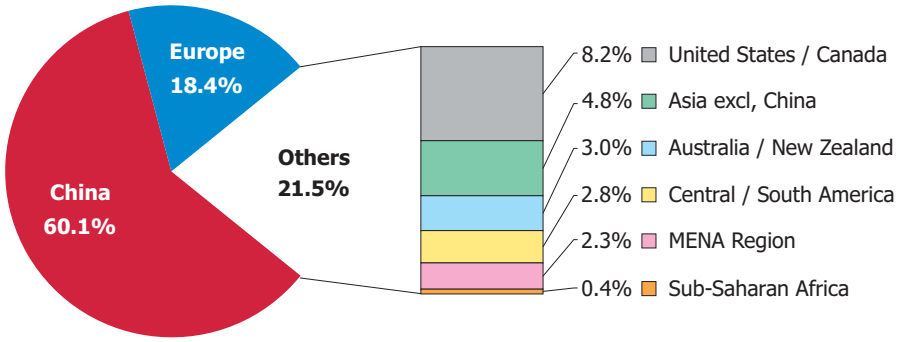
With respect to the methodology of the Chinese Solar Thermal Industry Federation (CSTIF) the operation lifetime is considered to be 10 years in China.

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 2010, an installed capacity of 195.8 GW_{th} corresponding to a total of 279.7 million square meters of collector area was in operation in the 55 countries recorded in this report. These 55 countries represent 4.2 billion people, which is 61% of the world's population. The installed capacity in these countries represents more than 90% of the solar thermal market worldwide.

The vast majority of the total capacity in operation was installed in China (117.6 GW_{th}) and Europe (36.0 GW_{th}), which together accounted for 78.5% of total installed. The remaining installed capacity was shared between the United States and Canada (16.0 GW_{th}), Asia excluding China (9.4 GW_{th}), Australia and New Zealand (6.0 GW_{th}), Central and South America (5.5 GW_{th}), the MENA[3] countries Israel, Jordan, Lebanon, Morocco and Tunisia (4.4 GW_{th}) as well as between some Sub-Saharan African countries (0.8 GW_{th}), namely Namibia, South Africa and Zimbabwe.



Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

Figure 3: Share of the total installed capacity in operation (glazed and unglazed water and air collectors) by economic regions at the end of 2010

As shown in **Table 1** and **Table 2**, the total capacity is divided into 62.1 GW_{th} flat plate collectors, referred to as FPC, (88.8 million square meters) and 111 GW_{th} evacuated tube collectors, referred to as ETC, (158.5 million square meters), 21.5 GW_{th} unglazed water collectors (30.7 million square meters) and 1.3 GW_{th} glazed and unglazed air collectors (1.8 million square meters).

3 Middle East and North Africa

Country	Water Collectors***			Air Collectors***		TOTAL [MW_{th}]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		54.0	0.4			54.4
Australia	3,780.0	1,964.1	76.8			5,820.9
Austria	419.6	2,724.6	46.5	0.5		3,191.3
Barbados*		92.2				92.2
Belgium	32.8	198.7	22.9			254.5
Brazil	894.0	3,384.0				4,278.0
Bulgaria		32.3	0.5			32.7
Canada	459.5	33.4	12.9	214.6	3.2	723.7
Chile		19.7				19.7
China		9,448.3	108,151.7			117,600.0
Cyprus	2.4	626.9	6.9			636.1
Czech Republic	105.0	174.8	40.8			320.6
Denmark	14.4	365.3	5.7	2.3	12.6	400.2
Estonia		1.4	0.6			2.0
Finland	8.2	21.1	3.0			32.4
France incl. DOM	62.4	1,490.9	44.7			1,598.0
Germany	445.9	8,233.2	925.0		23.5	9,627.6
Greece		2,849.5	11.4			2,860.9
Hungary	5.7	83.8	21.1	0.6	0.2	111.3
India		2,413.2	365.8		11.4	2,790.4
Ireland	0.3	71.8	34.0			106.1
Israel	20.9	2,896.5		0.3		2,917.8
Italy	30.6	1,562.5	220.8			1,813.9
Japan		3,645.5	65.2		339.0	4,049.6
Jordan	4.2	538.3	153.0			695.5
Korea, South		1,096.4				1,096.4
Latvia		4.9	0.2			5.1
Lebanon**		243.8				243.8
Lithuania		3.0	0.2			3.2
Luxembourg		19.6	2.0			21.6
Macedonia*		17.5	0.5		0.003	18.0
Malta		22.5	7.9			30.4
Mexico	463.5	500.1	108.8		5.6	1,078.0
Morocco**		238.9				238.9
Namibia		14.5	0.9			15.4
Netherlands	277.5	283.4	7.0			567.9
New Zealand*	4.9	100.1	6.8			111.8
Norway	1.4	10.1	0.7		0.7	13.0
Poland		356.9	102.2			459.1
Portugal	1.7	512.2	13.8			527.7
Romania		65.8	11.2			77.0
Slovakia		84.5	10.5			95.0
Slovenia		105.5	9.1			114.6
South Africa	562.6	231.7	20.1			814.4
Spain	85.4	1,540.4	96.3			1,722.0
Sweden	98.0	171.5	39.9			309.4
Switzerland	149.0	521.6	35.1	606.9		1,312.6
Taiwan	0.1	1,379.2	52.8			1,432.1
Thailand*		64.0				64.0
Tunisia		319.3	23.5			342.8
Turkey		9,323.1				9,323.1
United Kingdom		307.8	87.5			395.3
United States	13,552.8	1,647.5	64.9		51.5	15,316.7
Uruguay*		8.5				8.5
Zimbabwe		12.6	0.2			12.7
TOTAL	21,482.7	62,132.6	110,911.7	825.2	447.8	195,800.0

* Total capacity in operation refers to the year 2009

** Newly included countries compared to the 2011 edition of this report

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

Table 1: Total capacity in operation by the end of 2010 [MW_{th}]

Country	Water Collectors***			Air Collectors***		TOTAL [m²]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		77,185	548			77,733
Australia	5,400,000	2,805,920	109,643			8,315,563
Austria	599,491	3,892,305	66,482	728		4,559,006
Barbados*		131,690				131,690
Belgium	46,875	283,926	32,708			363,509
Brazil	1,277,128	4,834,349				6,111,477
Bulgaria		46,086	650			46,736
Canada	656,485	47,758	18,456	306,549	4,616	1,033,864
Chile		28,159				28,159
China		13,497,591	154,502,409			168,000,000
Cyprus	3,363	895,503	9,918			908,784
Czech Republic	150,000	249,664	58,275			457,939
Denmark	20,515	521,810	8,084	3,264	18,000	571,673
Estonia		2,051	790			2,841
Finland	11,779	30,118	4,342			46,240
France incl. DOM	89,181	2,129,796	63,900			2,282,877
Germany	637,010	11,761,731	1,321,423		33,600	13,753,764
Greece		4,070,700	16,300			4,087,000
Hungary	8,088	119,711	30,103	800	350	159,052
India		3,447,384	522,616		16,320	3,986,320
Ireland	421	102,537	48,640			151,598
Israel	29,900	4,137,895		450		4,168,245
Italy	43,766	2,232,097	315,481			2,591,344
Japan		5,207,908	93,075		484,226	5,785,209
Jordan	5,940	768,992	218,570			993,502
Korea, South		1,566,319				1,566,319
Latvia		7,004	240			7,244
Lebanon**		348,312				348,312
Lithuania		4,218	300			4,518
Luxembourg		27,982	2,818			30,800
Macedonia*		25,020	724		4	25,748
Malta		32,167	11,302			43,469
Mexico	662,092	714,432	155,430		7,983	1,539,937
Morocco**		341,260				341,260
Namibia		20,699	1,307			22,006
Netherlands	396,410	404,821	10,000			811,231
New Zealand*	7,025	142,975	9,644			159,645
Norway	2,011	14,406	1,054		1,062	18,533
Poland		509,800	146,000			655,800
Portugal	2,435	731,693	19,665			753,793
Romania		93,996	16,000			109,996
Slovakia		120,692	15,055			135,746
Slovenia		150,656	13,042			163,698
South Africa	803,678	331,010	28,672			1,163,360
Spain	122,000	2,200,500	137,500			2,460,000
Sweden	140,000	245,000	57,000			442,000
Switzerland	212,850	745,150	50,110	867,000		1,875,110
Taiwan	85	1,970,300	75,461			2,045,847
Thailand*		91,392				91,392
Tunisia		456,200	33,500			489,700
Turkey		13,318,659				13,318,659
United Kingdom		439,738	125,045			564,783
United States	19,361,098	2,353,565	92,777		73,509	21,880,949
Uruguay*		12,096				12,096
Zimbabwe		17,959	237			18,196
TOTAL 2010	30,689,627	88,760,887	158,445,297	1,178,791	639,671	279,714,273

* Total capacity in operation refers to the year 2009

** Newly included countries compared to the 2011 edition of this report

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

Table 2: Total installed collector area in operation by the end of 2010 [m²]

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

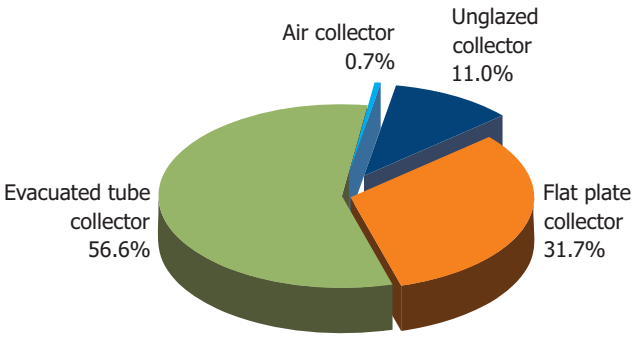


Figure 4: Distribution of the total installed capacity in operation by collector type in 2010

Figure 5 depicts the distribution of unglazed and glazed water collectors for the 10 leading countries by the end of 2010.

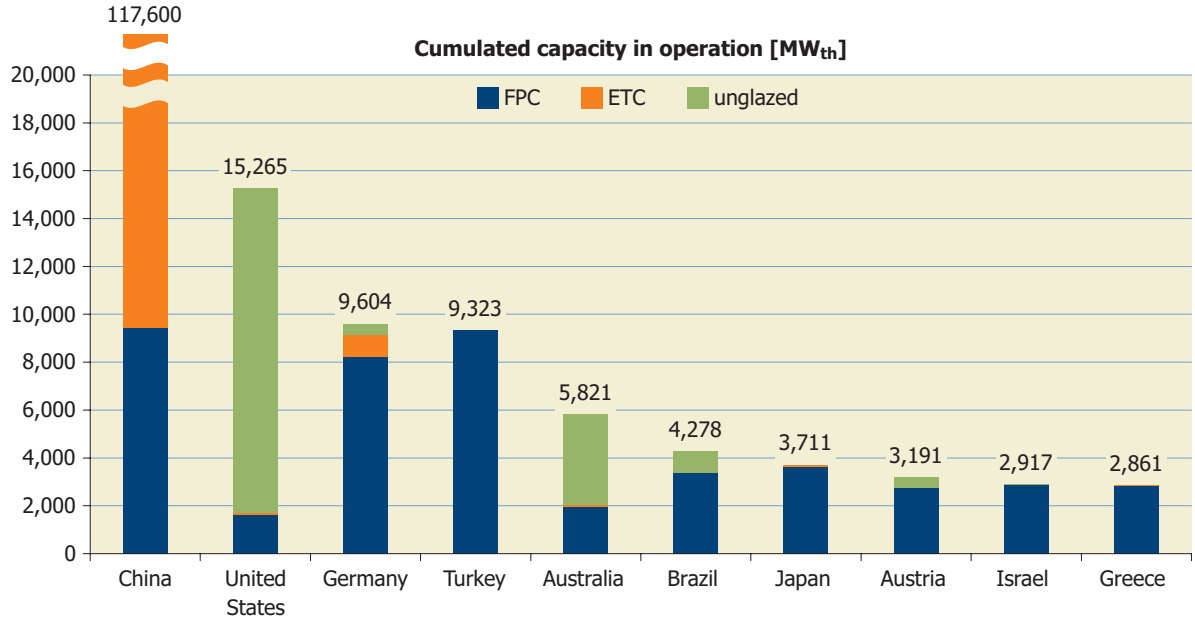


Figure 5: Total installed capacity of unglazed and glazed water collectors in operation in the 10 leading countries by the end of 2010

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 extend in Brazil do unglazed water collectors also play an important role. The rest of the "Top 10 countries" are clearly focusing on flat plate collector technology. With the dominance of the evacuated tube market in China, it is remarkable that this country is also the world leader in terms of total installed flat plate collectors (9.5 GW_{th}).

In terms of total installed capacity of glazed water collectors in operation per 1,000 inhabitants, there was a continued dominance by 5 countries (Cyprus, Israel, Austria, Barbados and Greece) but China entered the Top 10 for the first time, passing Malta (**Figure 7**).

3.2 Total capacity of glazed water collectors in operation

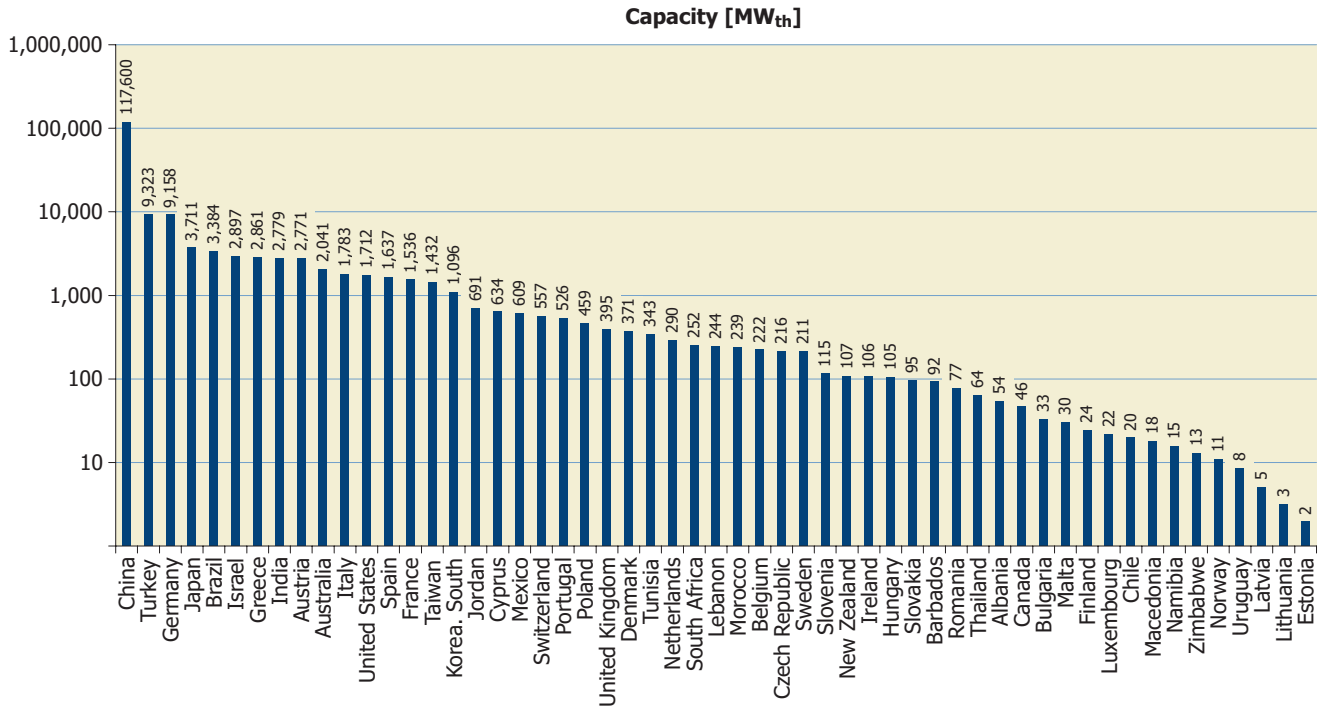


Figure 6: Total capacity of glazed flat plate and evacuated tube collectors in operation by the end of 2010 (note: logarithmic scale of y-axis)

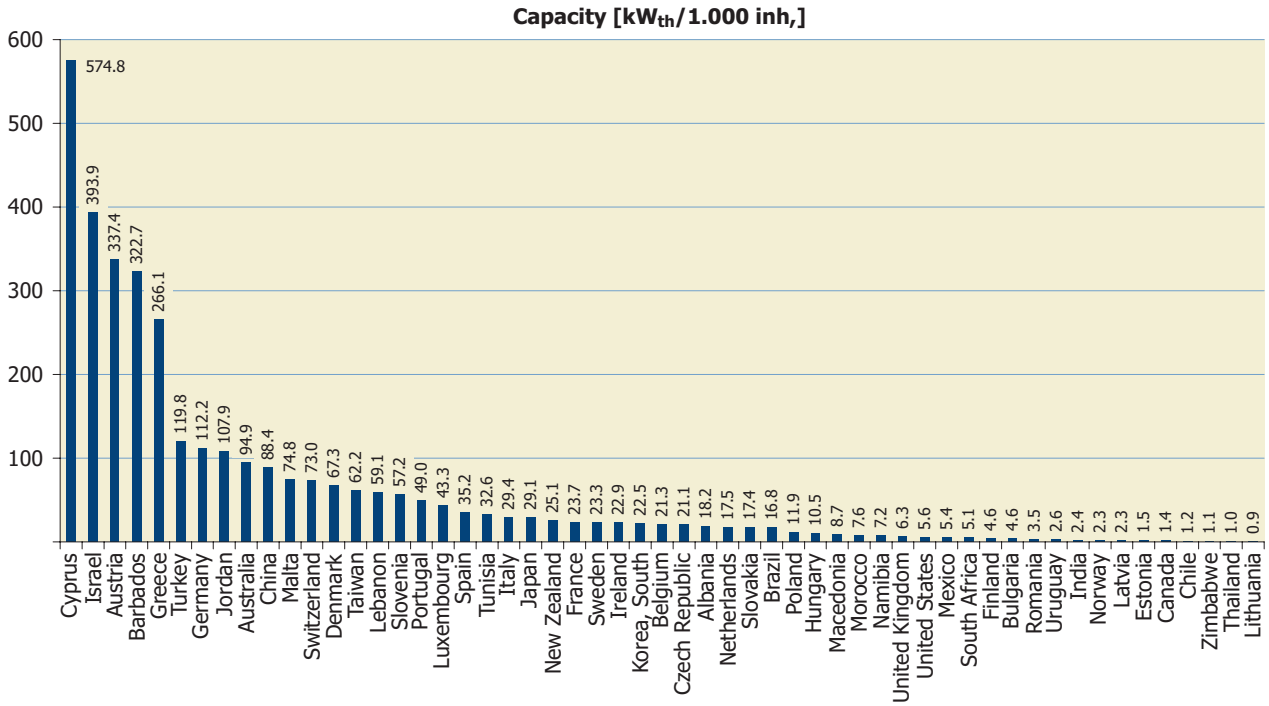


Figure 7: Total capacity of glazed flat plate and evacuated tube collectors in operation in kW_{th} per 1,000 inhabitants by the end of 2010

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

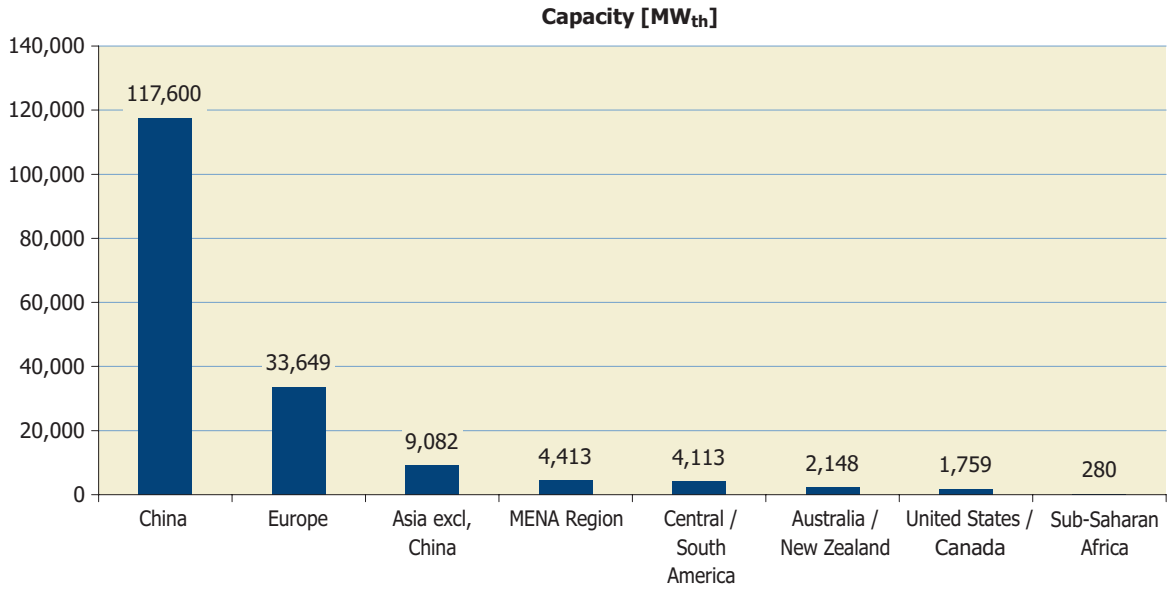


Figure 8: Total capacity of glazed flat plate and evacuated tube collectors in operation by economic region at the end of 2010

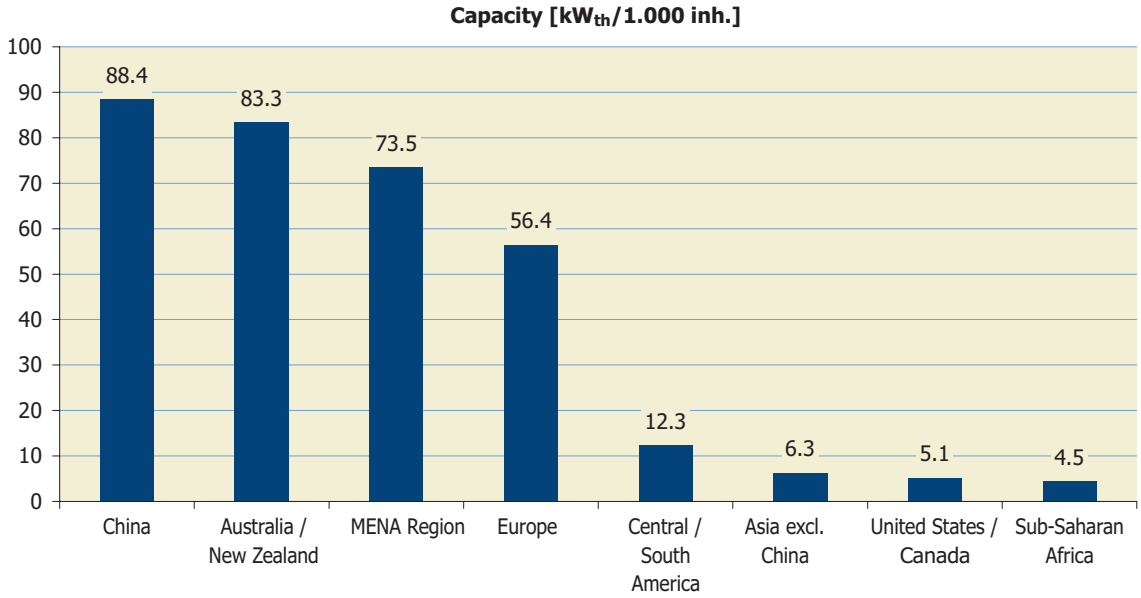


Figure 9: Total capacity of glazed flat plate and evacuated tube collectors in operation by economic region and in kW_{th} per 1,000 inhabitants by the end of 2010

Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

3.4 Total capacity of unglazed water collectors in operation

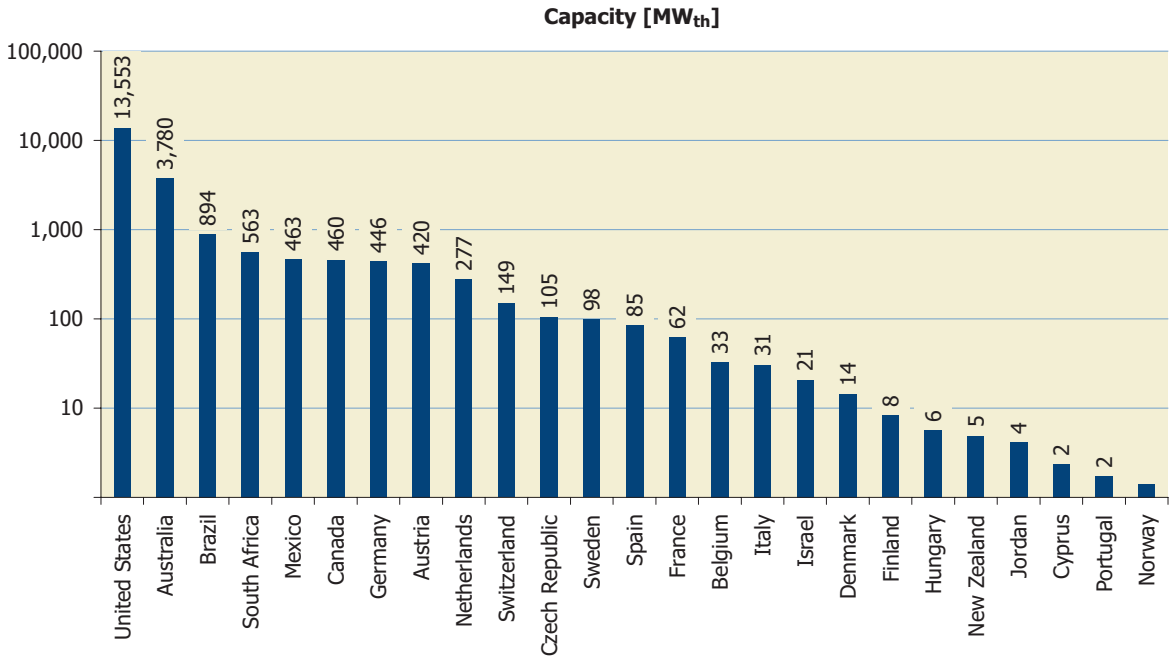


Figure 10: Total capacity of unglazed water collectors in operation by the end of 2010 (note: logarithmic scale of y-axis)

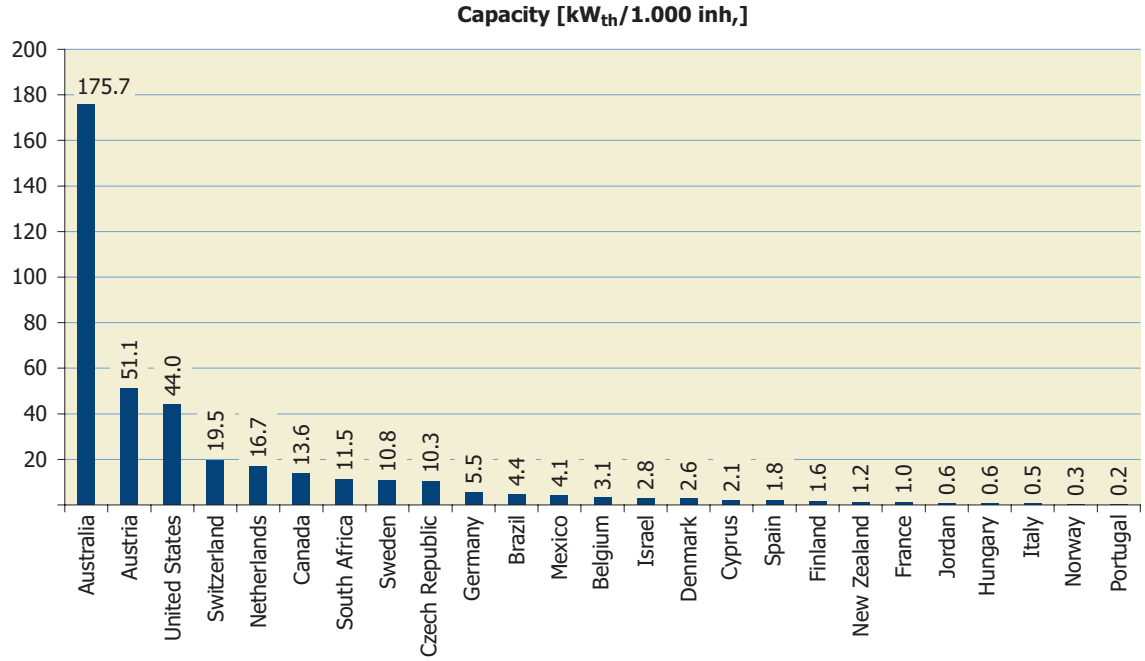


Figure 11: Total capacity of unglazed water collectors in operation in kW_{th} per 1,000 inhabitants by the end of 2010

3.5 Total capacity of unglazed water collectors in operation by economic region

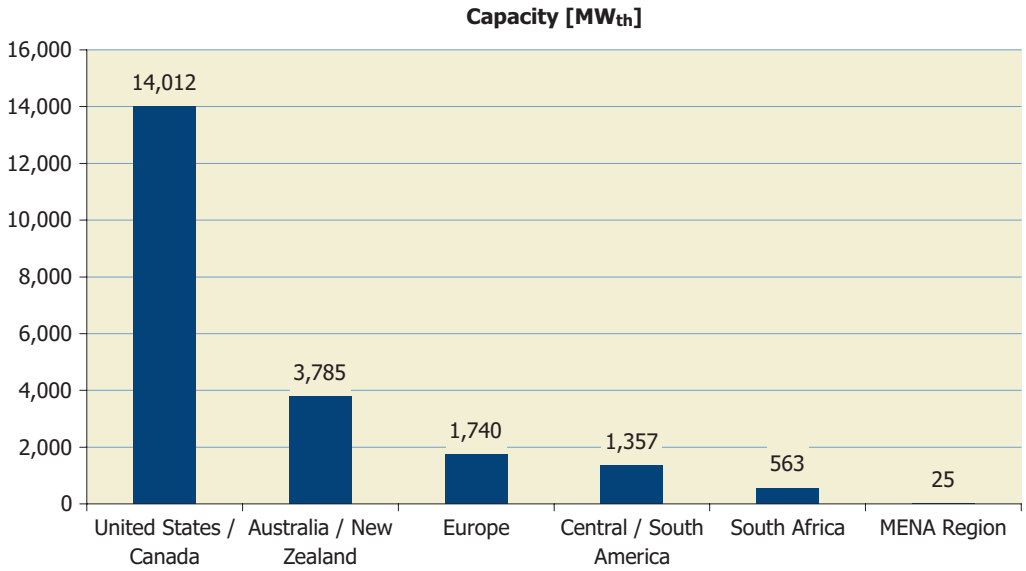


Figure 12: Total capacity of unglazed collectors in operation by economic region by the end of 2010

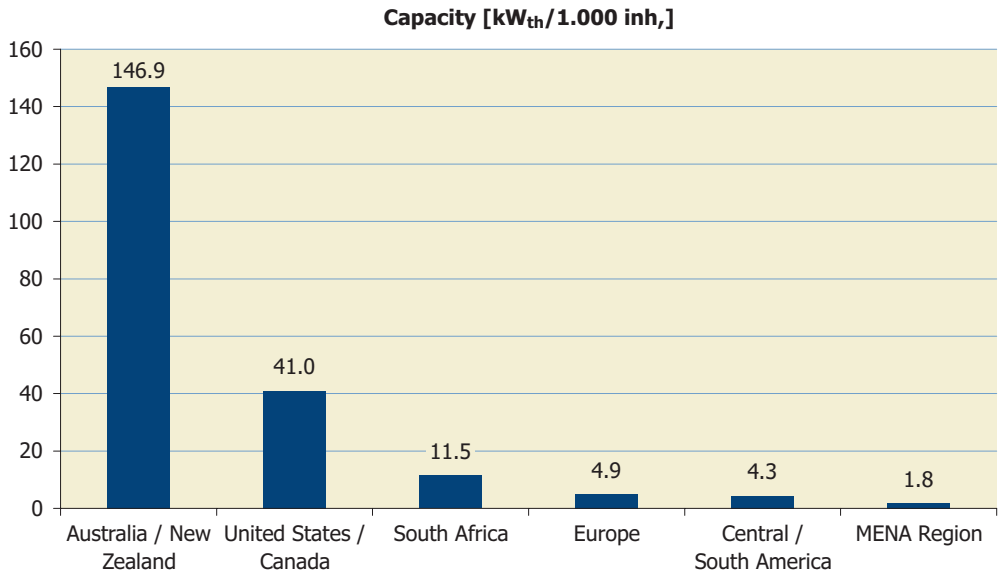


Figure 13: Total capacity of unglazed collectors in operation by economic region and in kW_{th} per 1,000 inhabitants by the end of 2010

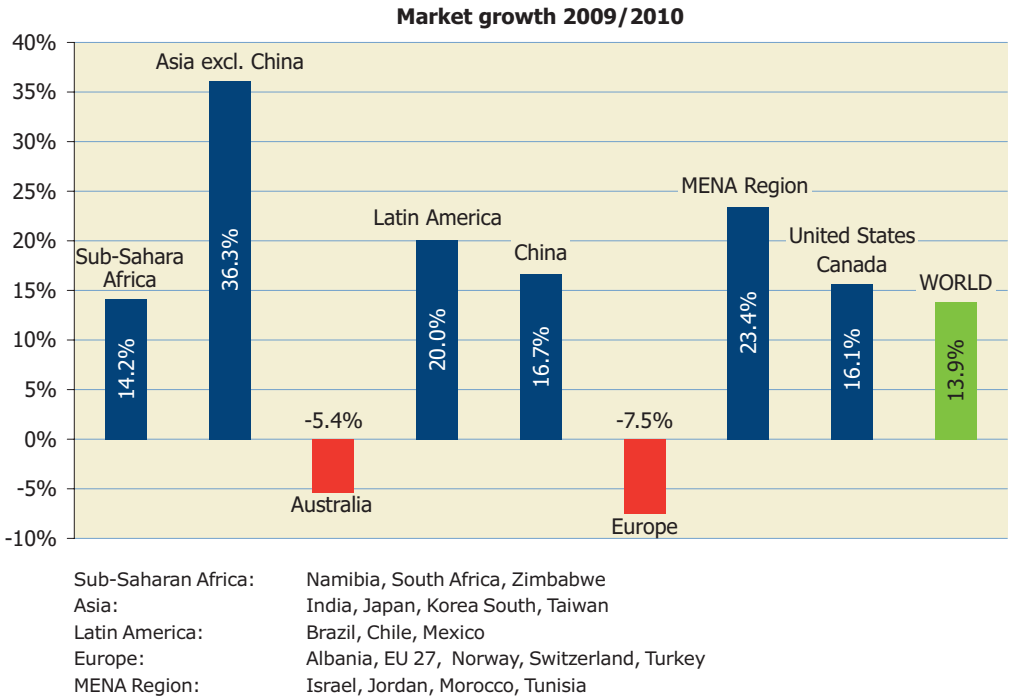
Central / South America:	Brazil, Mexico
Europe:	EU 17, Norway, Switzerland
MENA Region:	Israel, Jordan

4 Newly installed capacity in 2010 and market development

In the year 2010 a total capacity of 42.2 GW_{th}, corresponding to 60.2 million square meters of solar collectors, was installed worldwide. This means an increase in new collector installations of 13.9% compared to the year 2009[4].

The highest growth rates in the context of economic regions was in Asia with India and China leading the way. Whereas China has been the market leader in terms of quantities installed for more than a decade, India is becoming an important player with a fast growing market. By contrast, the mature European market has faced a significant market decrease for the second year in a row. In the period 2008/2009 the market dropped by 7.8% and 2009/2010 this trend continued with a decrease of 7.5%.

The United States and Canada recovered well in 2009/2010 from a downfall in the former period while in Australia the opposite occurred where the market grew almost 28% in 2008/2009 and in 2009/2010 has experienced a decrease of 5.4%, which is comparable to the decrease in the European market.



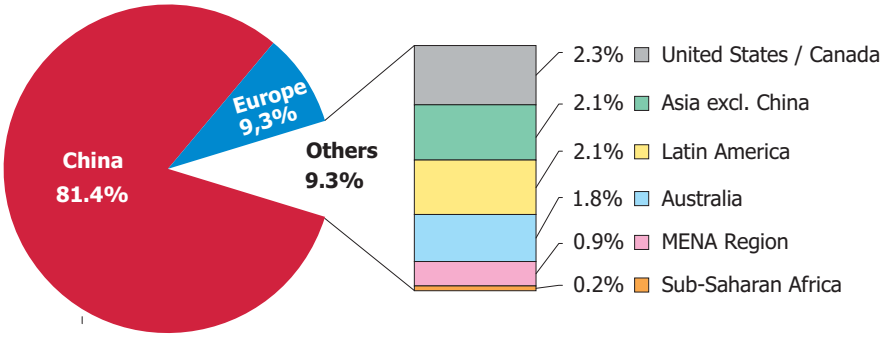
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe
Asia:	India, Japan, Korea South, Taiwan
Latin America:	Brazil, Chile, Mexico
Europe:	Albania, EU 27, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Morocco, Tunisia

Figure 14: Market development of the newly installed capacity between 2009 and 2010 by economic region

4 Not considered due to lack of information in 2010: Barbados, Lebanon, Macedonia, New Zealand, Thailand, Uruguay

4.1 General market overview of newly installed capacity

The main markets were in China (34.30 GW_{th}) and Europe (3.93 GW_{th}), which together account for 94.7% of the overall new collector installations in 2010. The rest of the market is shared between the United States and Canada (0.95 GW_{th}), Asia excluding China (0.88 GW_{th}), Latin America (0.87 GW_{th}), Australia (0.76 GW_{th}), the MENA region represented by Israel, Jordan, Lebanon, Morocco and Tunisia (0.40 GW_{th}) and the Sub-Saharan African countries Namibia, South Africa and Zimbabwe (0.08 GW_{th}).



Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe
Asia:	India, Japan, Korea South, Taiwan
Latin America:	Brazil, Chile, Mexico
Europe:	Albania, EU 27, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Morocco, Tunisia

Figure 15: Share of the newly installed capacity (glazed and unglazed water and air collectors) by economic regions in 2010

The total capacity is divided into 7.56 GW_{th} glazed flat plate collectors, referred to as FPC (10.80 million square meters), 32.79 GW_{th} evacuated tube collectors, referred to as ETC (46.84 million square meters), 1.73 GW_{th} unglazed water collectors (2.47 million square meters) and 0.08 GW_{th} glazed and unglazed air collectors (0.12 million square meters).

Country	Water Collectors**			Air Collectors**		TOTAL [MW_{th}]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		5.2	0.1			5.3
Australia	476.0	253.6	25.1			754.7
Austria	3.9	187.7	8.3	0.2		200.1
Belgium		21.9	4.9			26.8
Brazil	345.6	331.1				676.7
Bulgaria		5.4	0.5			5.9
Canada	59.3	8.0	8.0	62.7	1.6	139.6
Chile		5.6				5.6
China		2,100.0	32,200.0			34,300.0
Cyprus	0.1	23.1	1.2			24.4
Czech Republic	37.1	51.7	12.4			101.2
Denmark		43.4	0.3			43.6
Estonia		0.1	0.3			0.4
Finland		2.8	1.4			4.2
France incl. DOM		221.9	6.3			228.2
Germany		724.5	80.5			805.0
Greece		148.8	1.1			149.8
Hungary	1.7	10.3	4.4	0.2	0.1	16.7
India		425.9	196.3			622.2
Ireland		12.2	9.2			21.4
Israel		221.2				221.2
Italy		299.3	43.8			343.0
Japan		102.8	3.4		8.3	114.5
Jordan	4.2	55.7	8.9			68.8
Korea, South		48.9				48.9
Latvia		0.1	0.1			0.1
Lithuania		0.0	0.1			0.1
Luxembourg		2.5	0.7			3.2
Malta		1.2	0.8			2.0
Mexico	63.0	66.5	59.5		1.8	190.8
Morocco*		48.5				48.5
Namibia		3.8	0.6			4.4
Netherlands	18.6	32.1	2.8			53.5
Norway	0.1	1.5	0.6			2.2
Poland		77.7	24.5			102.2
Portugal	0.2	130.9	0.2			131.4
Romania		6.0	4.9			10.9
Slovakia		9.0	1.5			10.5
Slovenia		10.5	2.8			13.3
South Africa	35.0	29.6	5.4			70.0
Spain	7.7	220.9	15.1			243.6
Sweden	12.0	9.5	5.0			26.5
Switzerland	8.4	90.3	11.0	5.6		115.3
Taiwan	0.0	81.2	8.3			89.4
Tunisia		50.5	8.8			59.3
Turkey		1,160.6				1,160.6
United Kingdom		52.9	20.7			73.6
United States	656.5	157.8				814.3
Zimbabwe		0.3	0.1			0.4
TOTAL	1,729.3	7,554.7	32,789.4	68.7	11.8	42,154.0

* Newly included countries compared to the 2011 edition of this report

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

Table 3: Newly installed capacity in 2010 [MW_{th}/a]

Country	Water Collectors**			Air Collectors**		TOTAL [m²]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		7,480	82			7,562
Australia	680,000	362,351	35,837			1,078,188
Austria	5,539	268,093	11,805	350		285,787
Belgium		31,306	6,995			38,301
Brazil	493,725	472,956				966,681
Bulgaria		7,750	650			8,400
Canada	84,690	11,481	11,493	89,560	2,267	199,491
Chile		7,937				7,937
China		3,000,000	46,000,000			49,000,000
Cyprus	109	32,931	1,782			34,822
Czech Republic	53,000	73,898	17,719			144,617
Denmark		61,944	400			62,344
Estonia		100	400			500
Finland		4,000	2,000			6,000
France incl. DOM		317,000	9,000			326,000
Germany		1,035,000	115,000			1,150,000
Greece		212,500	1,500			214,000
Hungary	2,400	14,700	6,300	300	150	23,850
India		608,436	280,369			888,805
Ireland		17,472	13,109			30,581
Israel		316,000				316,000
Italy		427,500	62,500			490,000
Japan		146,866	4,794		11,850	163,511
Jordan	5,940	79,621	12,654			98,215
Korea, South		69,805				69,805
Latvia		100	100			200
Lithuania		50	150			200
Luxembourg		3,500	1,000			4,500
Malta		1,759	1,101			2,860
Mexico	90,000	95,000	85,000		2,580	272,580
Morocco*		69,260				69,260
Namibia		5,440	860			6,300
Netherlands	26,507	45,862	4,000			76,369
Norway	170	2,123	813			3,106
Poland		111,000	35,000			146,000
Portugal	353	186,990	302			187,645
Romania		8,500	7,000			15,500
Slovakia		12,800	2,200			15,000
Slovenia		15,000	4,000			19,000
South Africa	50,000	42,300	7,700			100,000
Spain	11,000	315,500	21,500			348,000
Sweden	17,191	13,567	7,132			37,890
Switzerland	11,944	129,026	15,746	8,000		164,716
Taiwan	2	115,938	11,811			127,751
Tunisia		72,200	12,500			84,700
Turkey		1,658,000				1,658,000
United Kingdom		75,600	29,600			105,200
United States	937,856	225,383				1,163,239
Zimbabwe		450	75			525
TOTAL	2,470,426	10,792,474	46,841,980	98,210	16,847	60,219,937

* Newly included countries

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

Table 4: Newly Installed collector area in 2010 [m²/a]

As can be seen in **Figure 16** evacuated tube collectors represent 77.8% and was by far the largest market share in a worldwide context, followed by flat plate collectors totaling in 17.9%, unglazed water collectors with 4.1% and 0.2% of glazed and unglazed air collectors. In total, glazed water collectors (ETC + FPC) account for 95.7% of the total market.

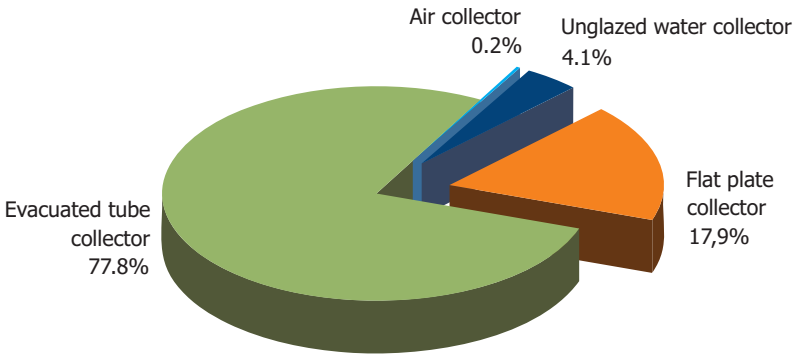


Figure 16: Distribution of the newly installed capacity by collector type in 2010

Figure 17 depicts the newly installed capacity of glazed and unglazed water collectors for the 10 leading markets in 2010 in total numbers.

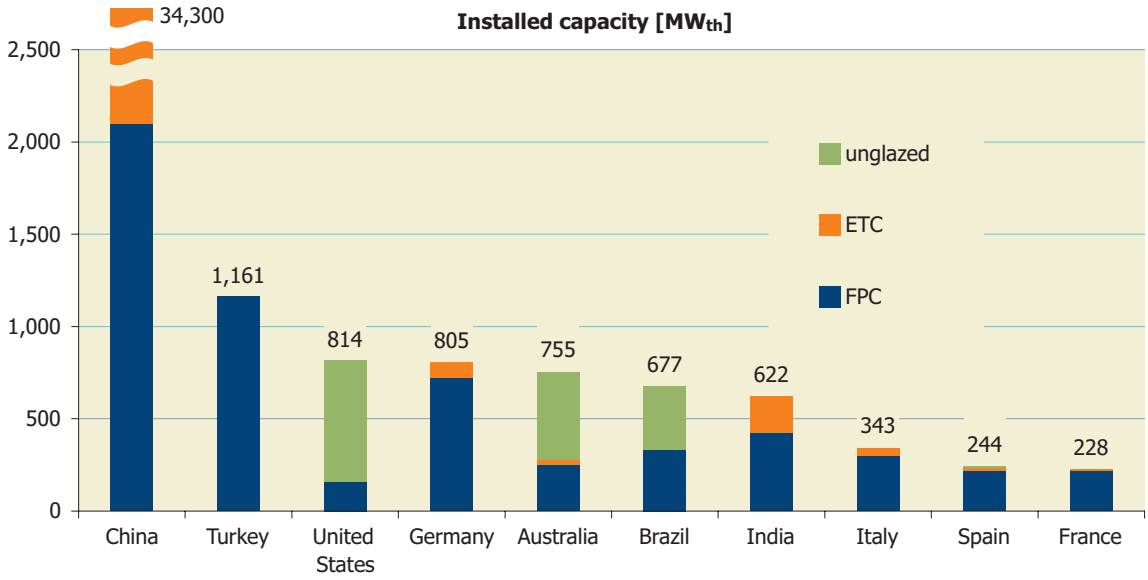


Figure 17: Total capacity of newly installed glazed and unglazed water collectors in the 10 leading countries in 2010

Compared to the newly installed capacity in 2009, China remained the market leader, however, Germany lost its second place position to Turkey and the United States, and Austria was displaced by France (including overseas departments) from the Top 10 ranking in 2010.

4.2 Newly installed capacity of glazed water collectors

For glazed water collectors (FPC and ETC) the solar thermal market in 2010 grew by 13.8% with China once again as the strong driver for this successful development. Other than in 2009 when Germany held this position, Turkey has had the second largest market (see **Figure 18**).

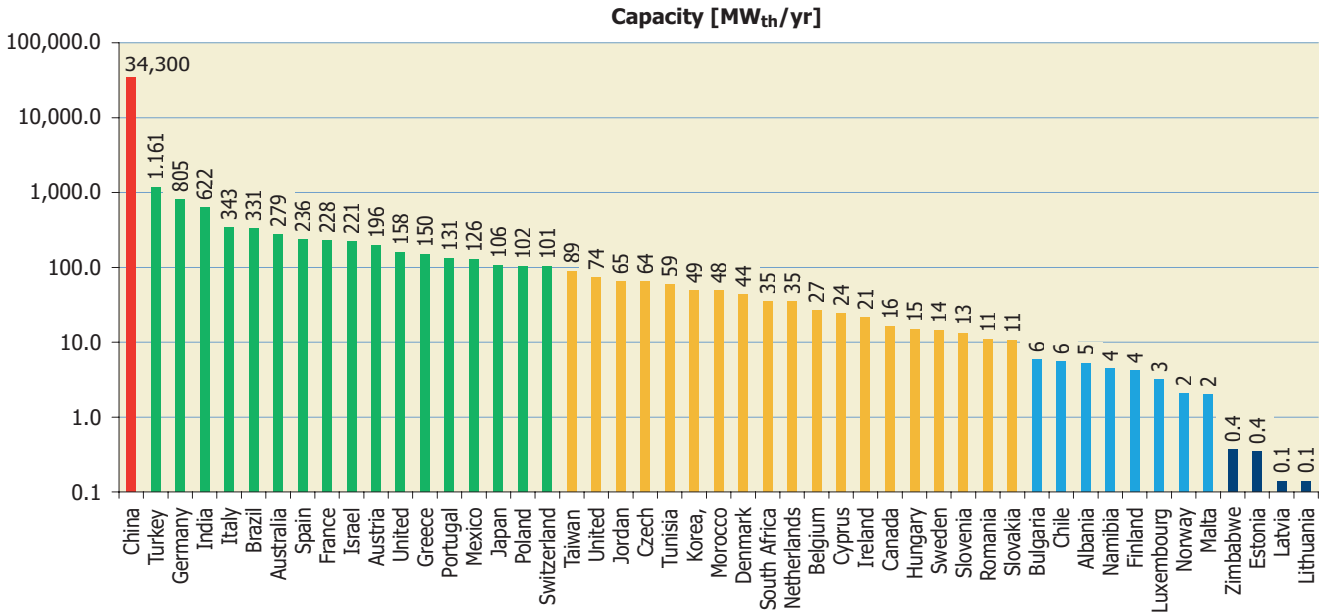


Figure 18: Newly installed capacity of glazed water collectors in 2010

In terms of newly installed capacity per 1,000 inhabitants, it is remarkable that China was close to leading the market only behind Israel, and ahead of Austria, Cyprus and Turkey. In other words this means that in 2010 43 m² of new solar thermal collector area was installed in Israel per 1,000 inhabitants where the population accounted for about 7.4 million people and 37 m² was installed in China where the population accounted for more than 1,330 million people (see **Figure 19**).

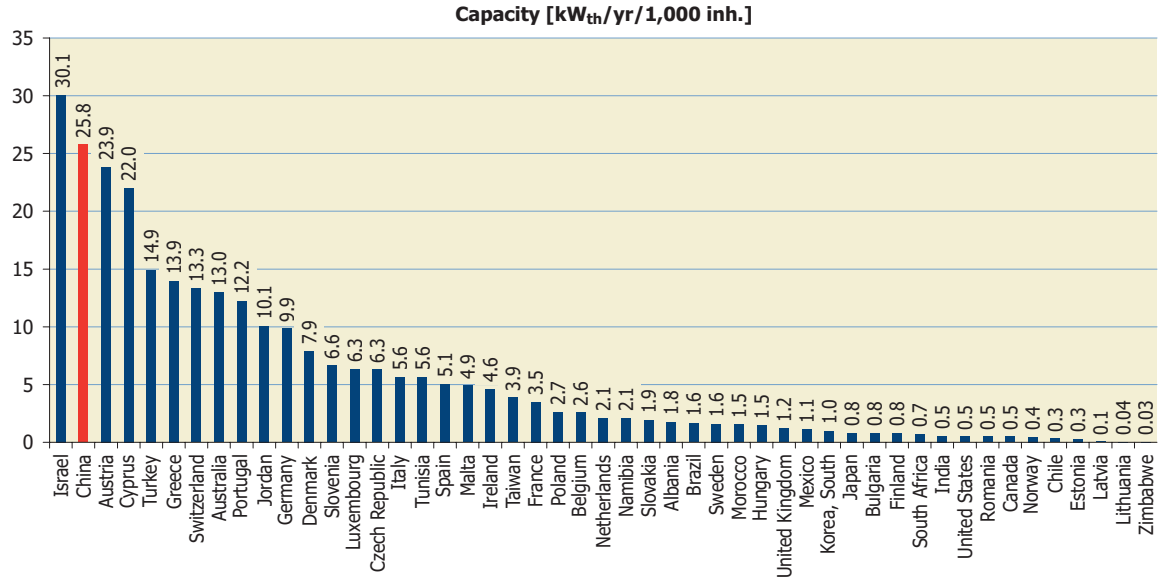


Figure 19: Newly installed capacity of glazed water collectors in 2010 in kW_{th} per 1,000 inhabitants

4.3 Market development of glazed water collectors between 2000 and 2010

The worldwide market development of glazed water collectors is characterized by a steady growth over the past decade. Between 2000 and 2010 the average growth rate worldwide was about 21%.

Between 2000 and 2010 the annual installed glazed water collector area worldwide increased 6-fold, and compared to the year 2009 the worldwide market grew by 13.8%. Regardless of this positive development, it should be noted that the growth 2009/2010 rate was the lowest since the period 2004/2005 (see **Figure 20**).

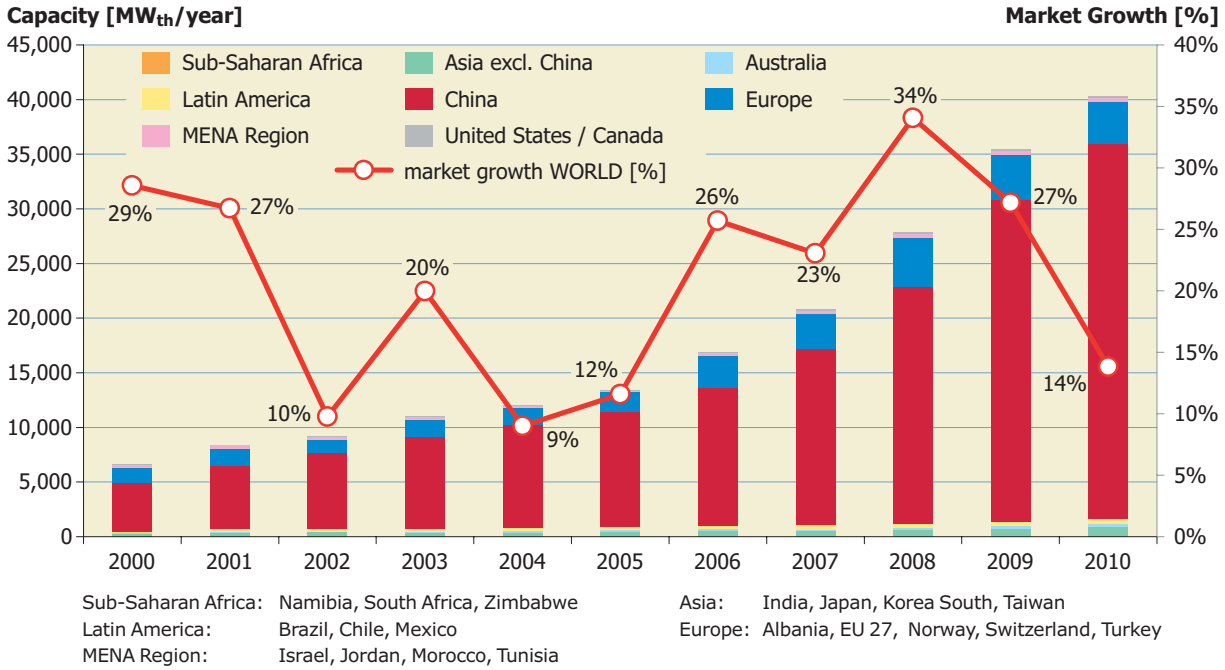


Figure 20: Annual installed capacity of flat plate and evacuated tube collectors from 2000 to 2010

The strong influence of the Chinese market on the worldwide market development is illustrated below in **Figure 21**.

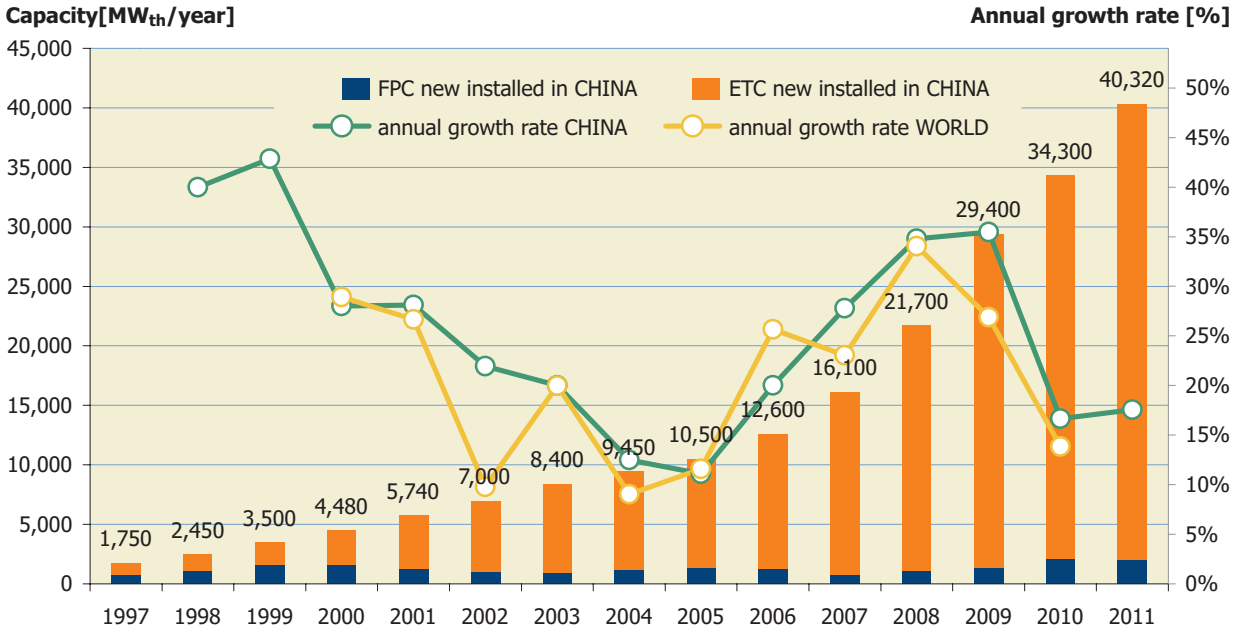


Figure 21: Annual installed capacity of flat-plate and evacuated tube collectors in China from 1997 to 2011 in comparison to the annual growth rates in China and the World

Figure 22 shows the market development between 2000 and 2010 for the annually installed capacity of glazed water collectors per 1,000 inhabitants.

In the year 2000, the installed capacity per capita was similar in Australia, China and Europe and some MENA countries, most notably Israel and Jordan which peaked at a high level at this time. Since 2000 the Chinese and Australian markets have grown steadily while the European market has experienced average growth with some fluctuations. By 2009/2010, the European market decreased along with the Australian market in 2010 while in China the upwards trend has remained unbroken.

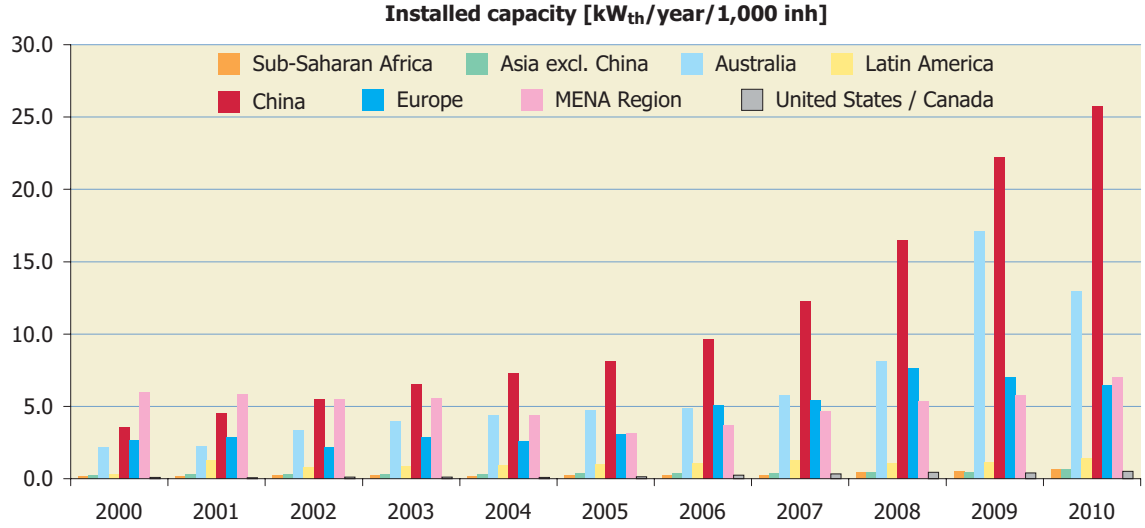


Figure 22: Annual installed capacity of flat plate and evacuated tube collectors in kW$_{th}$ per 1,000 inhabitants from 2000 to 2010

4.4 Market development of unglazed water collectors between 2000 and 2010

The worldwide market of unglazed collectors recorded a significant increase in 2001 and remained steady between 2001 and 2003. After a slight increase from 2004 to 2006, the installed capacity rate stagnated in 2007, mainly due to a market decline in the United States and Canada.

From 2007 to 2010 the market fluctuated primarily due to changing markets in the United States and in South America, most notably in Brazil. The large US market remained stable between 2007 and 2008 before a significant decrease in 2009 and then a market recovery in 2010. In contrast, the Australian market for unglazed water collectors remained quite stable at a high level between 2007 and 2010 and the Brazilian market experienced very high growth rates during the same period.

In total, new installations of unglazed water collectors increased by 13.6% in 2010 compared to 2009, accounting for 1.73 GW_{th} respectively 2.47 millions of square meters.

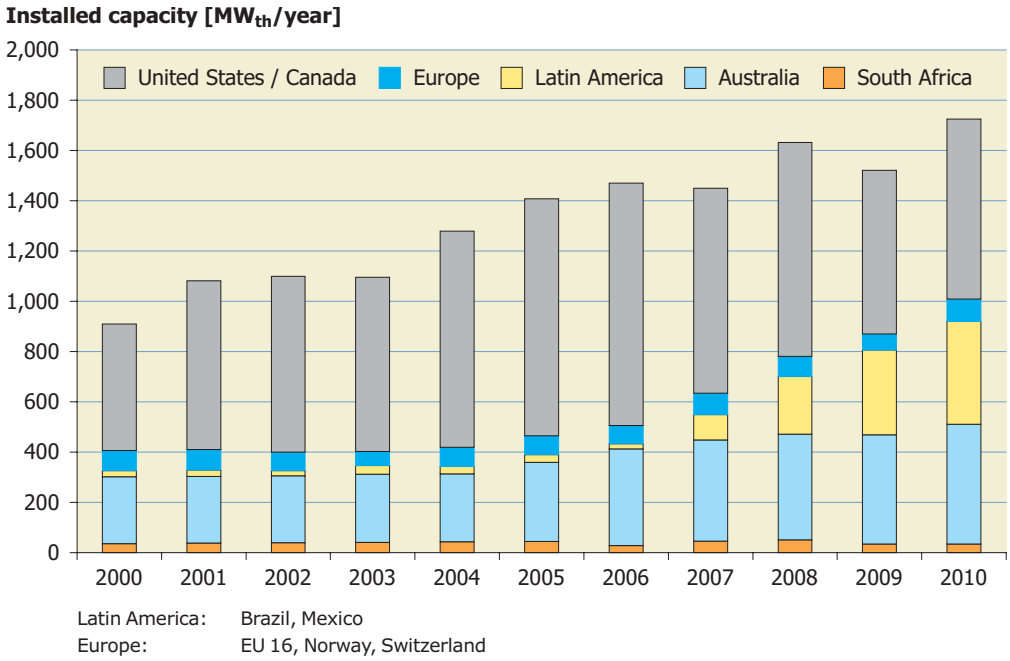


Figure 23: Annual installed capacity of unglazed water collectors from 2000 to 2010

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 corresponding annual energy gains, energy savings expressed as oil equivalents and CO_2 emission savings from the systems installed considering different types of solar collectors, geographic regions and types of applications are calculated with the simulation tool T-SOL expert 4.5 (www.valentin.de).

The annual collector yield of all water-based solar thermal systems in operation by the end of 2010 in the 55 recorded countries is 162,125 GWh (= 583,649 TJ). This corresponds to energy savings equivalent to 17.3 million tons of oil and 53.1 million tons of CO_2. The calculated number of different types of solar thermal systems in operation exceeds 53 million by the end of 2010.

For glazed water collectors, the cumulated capacity in operation by the end of 2010 of 173.0 GW_{th} led to an annual solar thermal collector yield of 149,985 GWh (= 539,947 TJ/a). This corresponds to annual oil savings of 16.1 million tons respectively to annual CO_2 savings of 49.5 million tons.

For unglazed water collectors, the total installed capacity in operation in 2010 of 21.5 GW_{th} led to an annual solar thermal collector yield of 12,139 GWh (= 43,702 TJ/a). This corresponds to energy savings equivalent to 1.2 million tons of oil and 3.6 million tons of CO_2.

The contribution of the total installed air collector capacity in operation in 2010 (1.3 GW_{th}) was not taken into consideration – with a share of around 0.6% of the total installed collector capacity, air collectors were omitted from the calculation.

Within the standardization of definitions for renewable heat by EUROSTAT and IEA SHC, a new calculation method for the annual solar yield was used in this report as well as in the 2011 edition of this report:

"Solar thermal production (solar yield) is equal to the solar collector output".

This new definition led to higher annual solar yields than reported in all reports prior to the 2011 edition.

Please find the description of the methodology in the appendix (see Chapter 7.1).

Table 5 summarizes the calculated annual collector yields and the corresponding oil equivalents and CO_2 reductions of all solar thermal systems (systems for hot water, space heating and swimming pool heating) installed by the end of 2010.

Table 6 and **Table 7** show the results for glazed and unglazed water collectors accordingly.

In Chapters 5.1 to 5.3, the annual collector yield, energy savings and CO_2 savings by economic regions for total numbers and per 1,000 inhabitants are graphed.

Country	Total collector area [m²]	Total capacity [MW_{th}]	Calculated number of systems	Collector yield [GWh/a]	Collector yield [TJ/a]	Energy savings [toe/a]	CO_2 reduction [tCO_2/a]
Albania	77.733	54	10.121	57	205	6.107	18.747
Australia	8.315.563	5.821	636.198	4.971	17.897	504.255	1.548.050
Austria	4.558.278	3.191	429.307	1.832	6.594	194.841	598.156
Barbados	131.690	92	32.923	116	418	12.491	38.346
Belgium	363.509	254	79.393	146	527	15.584	47.841
Brazil	6.111.477	4.278	1.059.307	4.285	15.427	454.887	1.396.489
Bulgaria	46.736	33	8.595	24	88	2.619	8.039
Canada	722.699	506	9.462	293	1.053	28.419	87.247
Chile	28.159	20	3.542	21	77	2.285	7.014
China	168.000.000	117.600	38.295.600	97.682	351.654	10.498.876	32.231.249
Cyprus	908.784	636	200.009	808	2.908	86.807	266.495
Czech Republic	457.939	321	40.710	162	582	16.833	51.676
Denmark	550.409	385	115.849	246	885	26.354	80.906
Estonia	2.841	2	710	1	4	132	405
Finland	46.240	32	8.278	19	68	1.980	6.078
France incl. DOM	2.282.877	1.598	438.088	1.074	3.865	115.043	353.180
Germany	13.720.164	9.604	1.482.977	5.565	20.035	595.784	1.829.041
Greece	4.087.000	2.861	1.603.739	3.146	11.327	338.180	1.038.203
Hungary	157.902	111	15.731	75	270	8.027	24.644
India	3.970.000	2.779	809.880	3.397	12.229	365.114	1.120.889
Ireland	151.598	106	34.990	63	228	6.815	20.923
Israel	4.167.795	2.917	273.251	3.591	12.929	385.788	1.184.358
Italy	2.591.344	1.814	637.113	1.704	6.134	182.890	561.466
Japan	5.300.983	3.711	1.303.933	3.090	11.122	332.065	1.019.431
Jordan	993.502	695	201.492	941	3.387	101.084	310.324
Korea, South	1.566.319	1.096	225.863	819	2.948	88.020	270.219
Latvia	7.244	5	1.811	3	12	359	1.103
Lebanon	348.312	244	87.078	333	1.197	35.751	109.753
Lithuania	4.518	3	1.130	2	7	219	671
Luxembourg	30.800	22	7.700	14	50	1.488	4.569
Macedonia	25.744	18	3.298	15	56	1.665	5.111
Malta	43.469	30	10.867	38	136	4.055	12.448
Mexico	1.531.954	1.072	76.727	809	2.912	84.476	259.338
Morocco	341.260	239	85.315	349	1.256	37.486	115.080
Namibia	22.006	15	2.718	20	72	2.158	6.624
Netherlands	811.231	568	117.302	287	1.034	29.596	90.860
New Zealand	159.645	112	36.435	101	365	10.861	33.343
Norway	17.471	12	2.551	7	26	775	2.379
Poland	655.800	459	82.522	268	964	28.783	88.364
Portugal	753.793	528	136.008	583	2.099	62.643	192.312
Romania	109.996	77	27.499	65	235	7.018	21.546
Slovakia	135.746	95	22.624	65	235	7.013	21.530
Slovenia	163.698	115	24.757	68	245	7.320	22.472
South Africa	1.163.360	814	93.939	769	2.768	77.798	238.838
Spain	2.460.000	1.722	248.906	1.700	6.120	182.019	558.794
Sweden	442.000	309	25.514	160	577	16.739	51.387
Switzerland	1.008.110	706	107.709	393	1.414	41.500	127.404
Taiwan	2.045.847	1.432	485.562	1.249	4.497	134.272	412.211
Thailand	91.392	64	22.848	78	281	8.385	25.741
Tunisia	489.700	343	119.046	439	1.582	47.230	144.996
Turkey	13.318.659	9.323	3.084.601	10.846	39.044	1.165.688	3.578.630
United Kingdom	564.783	395	141.196	235	844	25.207	77.385
United States	21.807.440	15.265	504.529	9.076	32.674	885.972	2.719.908
Uruguay	12.096	8	3.024	8	30	886	2.720
Zimbabwe	18.196	13	4.549	16	56	1.671	5.128
TOTAL	277.895.811	194.527	53.524.825	162.125	583.649	17.280.312	53.050.066

Table 5: Calculated annual collector yield and corresponding oil equivalent as well as CO_2 reduction of glazed and unglazed water collectors in operation by the end of 2010

Country	Total collector area [m²]	Total capacity [MW_{th}]	Calculated number of systems	Collector yield [GWh/a]	Collector yield [TJ/a]	Energy savings [toe/a]	CO_2 reduction [tCO_2/a]
Albania	77.733	54	10.121	57	205	6.107	18.747
Australia	2.915.563	2.041	477.375	2.454	8.835	263.786	809.815
Austria	3.958.787	2.771	426.309	1.662	5.982	178.605	548.313
Barbados	131.690	92	32.923	116	418	12.491	38.346
Belgium	316.634	222	79.159	134	483	14.407	44.229
Brazil	4.834.349	3.384	1.052.921	3.807	13.706	409.188	1.256.197
Bulgaria	46.736	33	8.595	24	88	2.619	8.039
Canada	66.214	46	6.180	39	140	4.191	12.868
Chile	28.159	20	3.542	21	77	2.285	7.014
China	168.000.000	117.600	38.295.600	97.682	351.654	10.498.876	32.231.249
Cyprus	905.421	634	199.992	806	2.901	86.620	265.922
Czech Republic	307.939	216	39.960	116	419	12.496	38.361
Denmark	529.894	371	115.746	240	863	25.776	79.133
Estonia	2.841	2	710	1	4	132	405
Finland	34.461	24	8.219	15	55	1.633	5.014
France incl. DOM	2.193.696	1.536	437.642	1.044	3.760	112.248	344.599
Germany	13.083.154	9.158	1.479.792	5.366	19.316	576.700	1.770.454
Greece	4.087.000	2.861	1.603.739	3.146	11.327	338.180	1.038.203
Hungary	149.814	105	15.691	72	260	7.761	23.827
India	3.970.000	2.779	809.880	3.397	12.229	365.114	1.120.889
Ireland	151.177	106	34.987	63	228	6.803	20.885
Israel	4.137.895	2.897	273.101	3.574	12.867	384.166	1.179.380
Italy	2.547.578	1.783	636.895	1.684	6.064	181.042	555.794
Japan	5.300.983	3.711	1.303.933	3.090	11.122	332.065	1.019.431
Jordan	987.562	691	201.463	937	3.373	100.716	309.194
Korea, South	1.566.319	1.096	225.863	819	2.948	88.020	270.219
Latvia	7.244	5	1.811	3	12	359	1.103
Lebanon	348.312	244	87.078	333	1.197	35.751	109.753
Lithuania	4.518	3	1.130	2	7	219	671
Luxembourg	30.800	22	7.700	14	50	1.488	4.569
Macedonia	25.744	18	3.298	15	56	1.665	5.111
Malta	43.469	30	10.867	38	136	4.055	12.448
Mexico	869.862	609	73.416	603	2.170	64.779	198.871
Morocco	341.260	239	85.315	349	1.256	37.486	115.080
Namibia	22.006	15	2.718	20	72	2.158	6.624
Netherlands	414.821	290	115.320	179	646	19.289	59.218
New Zealand	152.620	107	36.400	98	354	10.583	32.490
Norway	15.460	11	2.541	7	24	714	2.192
Poland	655.800	459	82.522	268	964	28.783	88.364
Portugal	751.358	526	135.996	582	2.095	62.545	192.012
Romania	109.996	77	27.499	65	235	7.018	21.546
Slovakia	135.746	95	22.624	65	235	7.013	21.530
Slovenia	163.698	115	24.757	68	245	7.320	22.472
South Africa	359.682	252	89.920	363	1.307	39.011	119.763
Spain	2.338.000	1.637	248.296	1.642	5.912	176.522	541.918
Sweden	302.000	211	24.814	119	429	12.796	39.283
Switzerland	795.260	557	106.644	334	1.202	35.876	110.139
Taiwan	2.045.761	1.432	485.561	1.249	4.497	134.269	412.203
ItThailand	91.392	64	22.848	78	281	8.385	25.741
Tunisia	489.700	343	119.046	439	1.582	47.230	144.996
Turkey	13.318.659	9.323	3.084.601	10.846	39.044	1.165.688	3.578.630
United Kingdom	564.783	395	141.196	235	844	25.207	77.385
United States	2.446.342	1.712	407.724	1.579	5.685	169.730	521.065
Uruguay	12.096	8	3.024	8	30	886	2.720
Zimbabwe	18.196	13	4.549	16	56	1.671	5.128
TOTAL	247.206.184	173.044	53.239.553	149.985	539.947	16.120.526	49.489.555

Table 6: Calculated annual collector yield and corresponding oil equivalent as well as CO_2 reduction of glazed (FPC + ETC) water collectors in operation by the end of 2010

Country	Total collector area [m²]	Total capacity [MW_{th}]	Calculated number of systems	Collector yield [GWh/a]	Collector yield [TJ/a]	Energy savings [toe/a]	CO_2 reduction [tCO_2/a]
Albania							
Australia	5.400.000	3.780	158.824	2.517	9.061	240.469	738.234
Austria	599.491	420	2.997	170	612	16.236	49.843
Barbados							
Belgium	46.875	33	234	12	44	1.176	3.611
Brazil	1.277.128	894	6.386	478	1.722	45.698	140.292
Bulgaria							
Canada	656.485	460	3.282	254	913	24.228	74.379
Chile							
China							
Cyprus	3.363	2	17	2	7	187	573
Czech Republic	150.000	105	750	45	163	4.337	13.315
Denmark	20.515	14	103	6	22	578	1.774
Estonia							
Finland	11.779	8	59	4	13	347	1.064
France incl. DOM	89.181	62	446	29	105	2.795	8.581
Germany	637.010	446	3.185	200	719	19.084	58.588
Greece							
Hungary	8.088	6	40	3	10	266	816
India							
Ireland	421	0	2	0	0	12	37
Israel	29.900	21	150	17	61	1.622	4.979
Italy	43.766	31	219	19	70	1.848	5.672
Japan							
Jordan	5.940	4	30	4	14	368	1.130
Korea, South							
Latvia							
Lebanon							
Lithuania							
Luxembourg							
Macedonia							
Malta							
Mexico	662.092	463	3.310	206	742	19.696	60.467
Morocco							
Namibia							
Netherlands	396.410	277	1.982	108	388	10.307	31.642
New Zealand	7.025	5	35	3	10	278	853
Norway	2.011	1	10	1	2	61	187
Poland							
Portugal	2.435	2	12	1	4	98	301
Romania							
Slovakia							
Slovenia							
South Africa	803.678	563	4.018	406	1.462	38.787	119.076
Spain	122.000	85	610	58	207	5.497	16.877
Sweden	140.000	98	700	41	149	3.943	12.104
Switzerland	212.850	149	1.064	59	212	5.624	17.265
Taiwan	85	0	0	0	0	3	8
Thailand							
Tunisia							
Turkey							
United Kingdom							
United States	19.361.098	13.553	96.805	7.497	26.989	716.242	2.198.843
Uruguay							
Zimbabwe							
TOTAL	30.689.627	21.483	285.272	12.139	43.702	1.159.786	3.560.511

Table 7: Calculated annual collector yield and corresponding oil equivalent as well as CO_2 reduction of unglazed water collectors in operation by the end of 2010

5.1 Annual collector yield by economic region

5.1.1 Annual collector yield of glazed water collectors by economic region in 2010

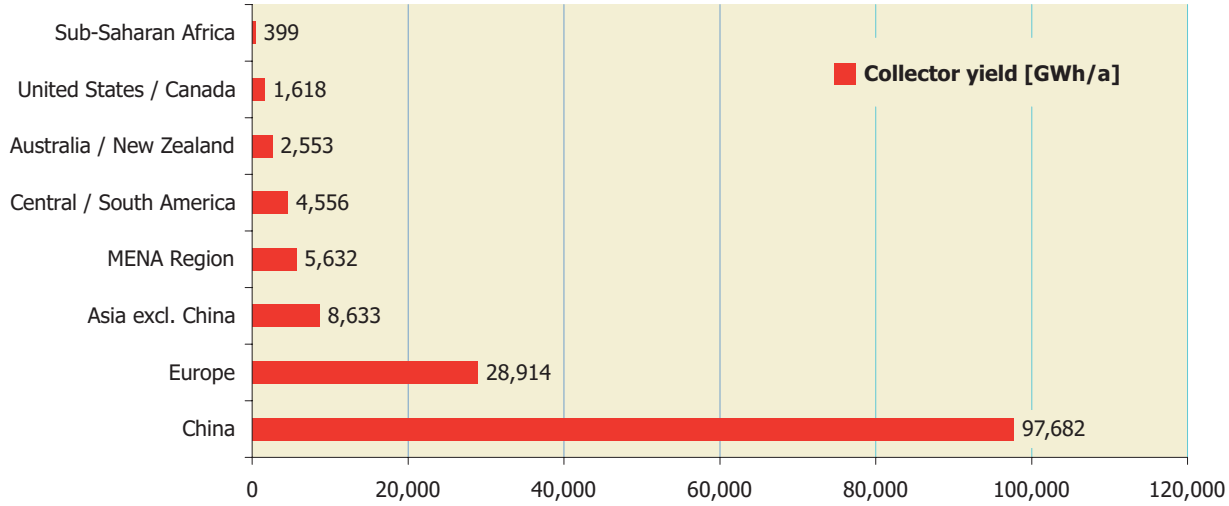


Figure 24: Annual collector yield of glazed (FPC + ETC) water collectors in operation by economic region in 2010

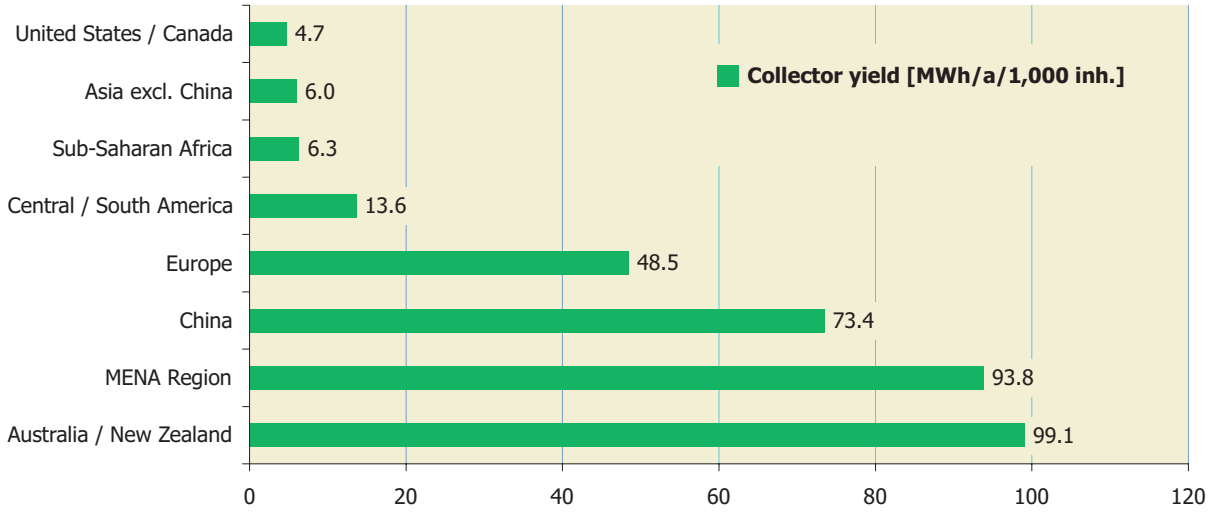


Figure 25: Annual collector yield of glazed (FPC + ETC) water collectors in operation by economic region in MWh per 1,000 inhabitants in 2010

Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

5.1.2 Annual collector yield of unglazed water collectors by economic region in 2010

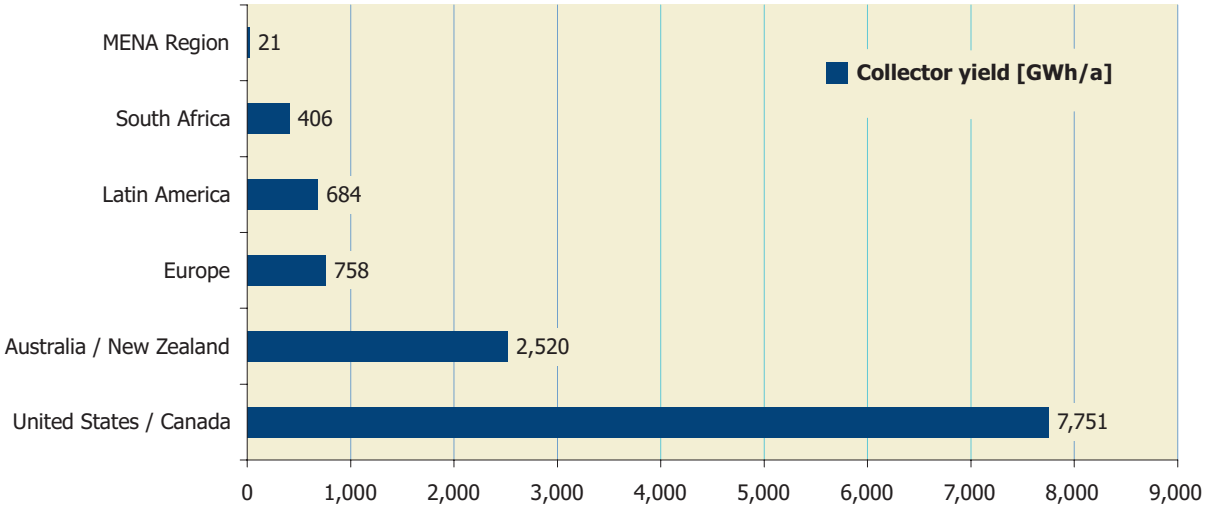


Figure 26: Annual collector yield of unglazed water collectors in operation by economic region in 2010

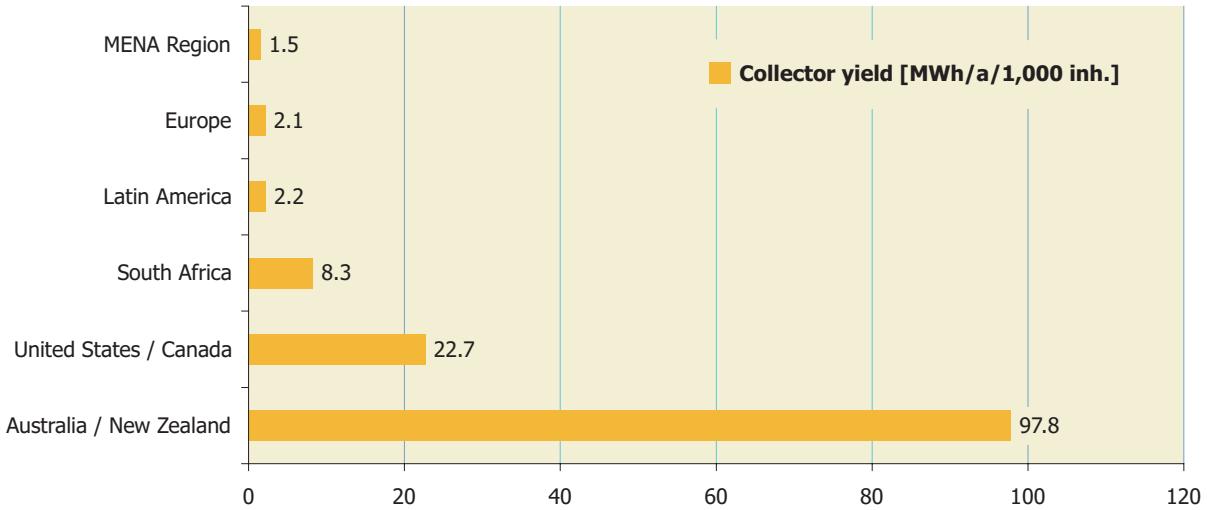


Figure 27: Annual collector yield of unglazed water collectors in operation by economic region in MWh per 1,000 inhabitants in 2010

Latin America:	Brazil, Mexico
Europe:	EU 16, Norway, Switzerland
MENA Region:	Israel, Jordan

5.2 Annual energy savings by economic region

5.2.1 Annual energy savings in oil equivalents by glazed water collectors by economic region in 2010

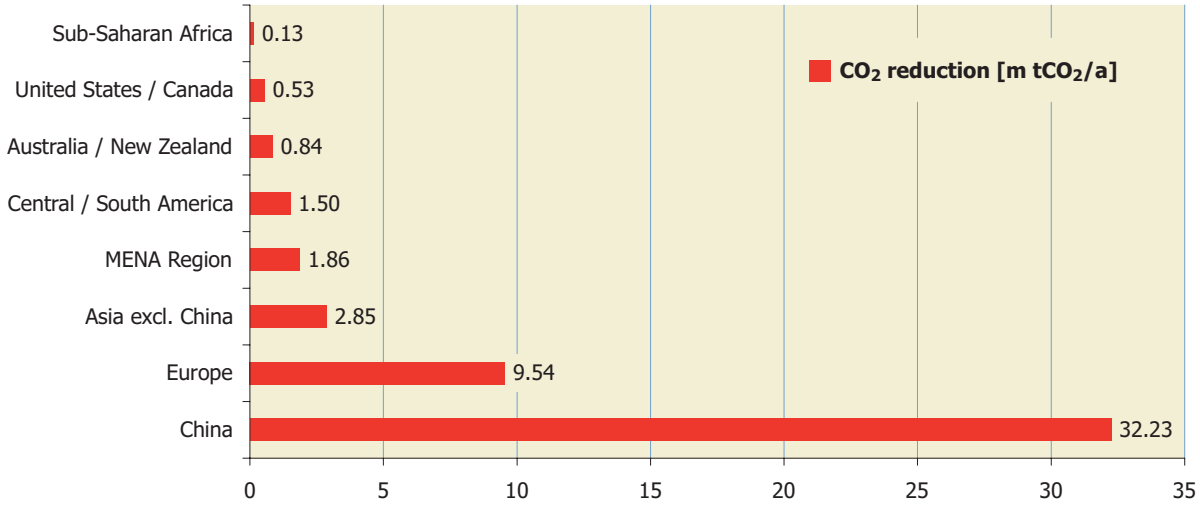


Figure 28: Annual energy savings in oil equivalent by glazed (FPC + ETC) water collectors in operation by economic region in 2010

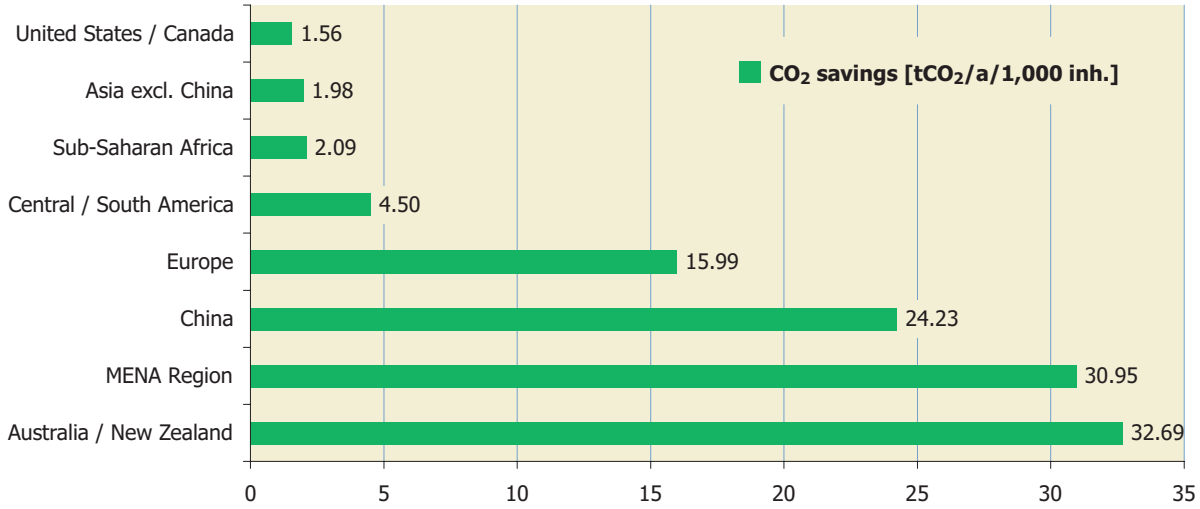


Figure 29: Annual energy savings in oil equivalent by glazed (FPC + ETC) water collectors in operation by economic region per 1,000 inhabitants in 2010

Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

5.2.2 Annual energy savings in oil equivalents by unglazed water collectors by economic region in 2010

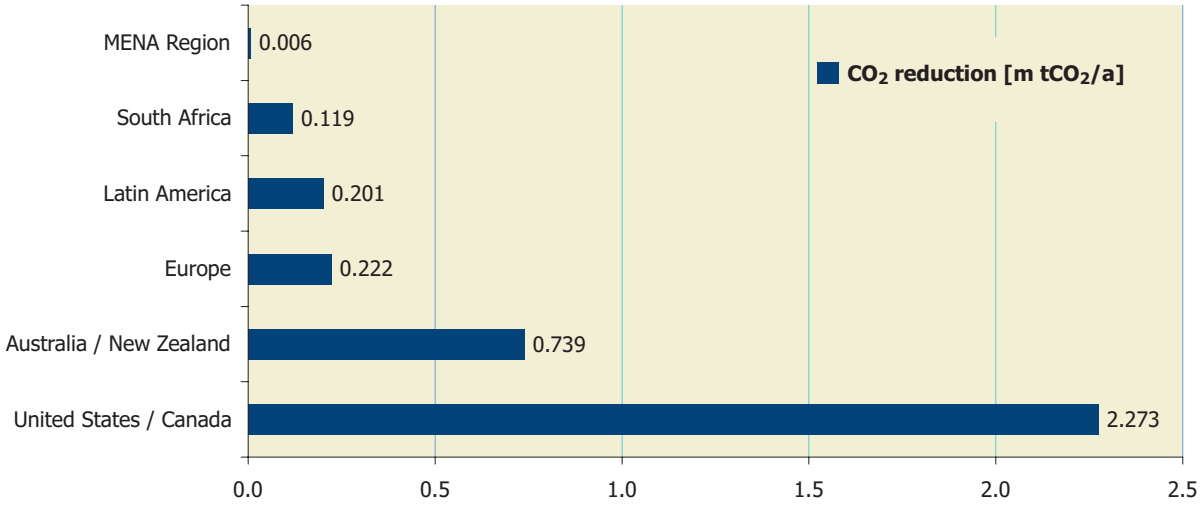


Figure 30: Annual energy savings in oil equivalents by unglazed water collectors in operation by economic region in 2010

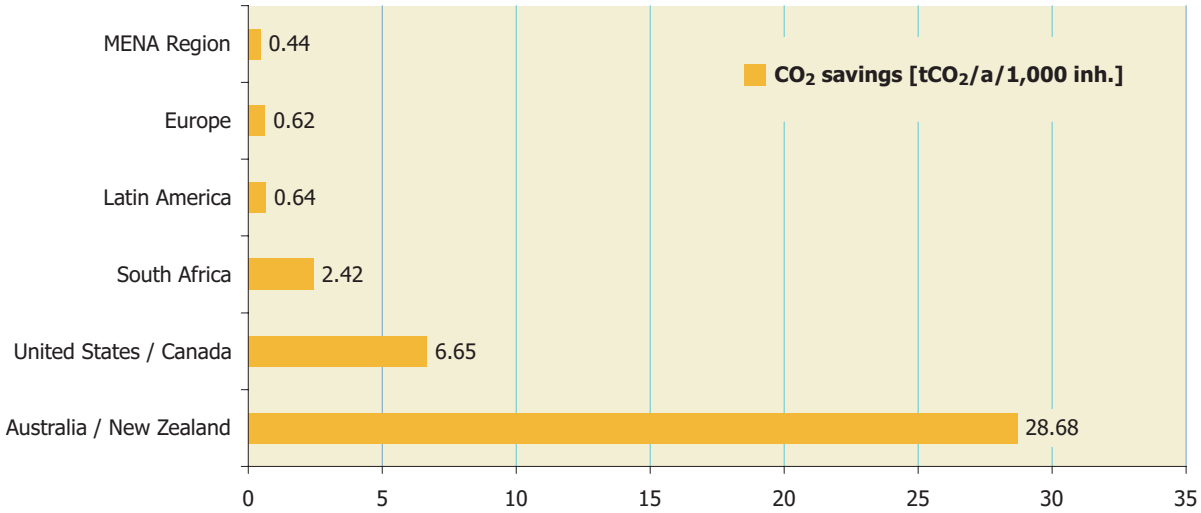


Figure 31: Annual energy savings in oil equivalent by unglazed water collectors in operation by economic region per 1,000 inhabitants in 2010

Latin America:	Brazil, Mexico
Europe:	EU 16, Norway, Switzerland
MENA Region:	Israel, Jordan

5.3 Annual contribution to CO_2 reduction by economic region

5.3.1 Annual CO_2 reduction by glazed water collectors and economic region in 2010

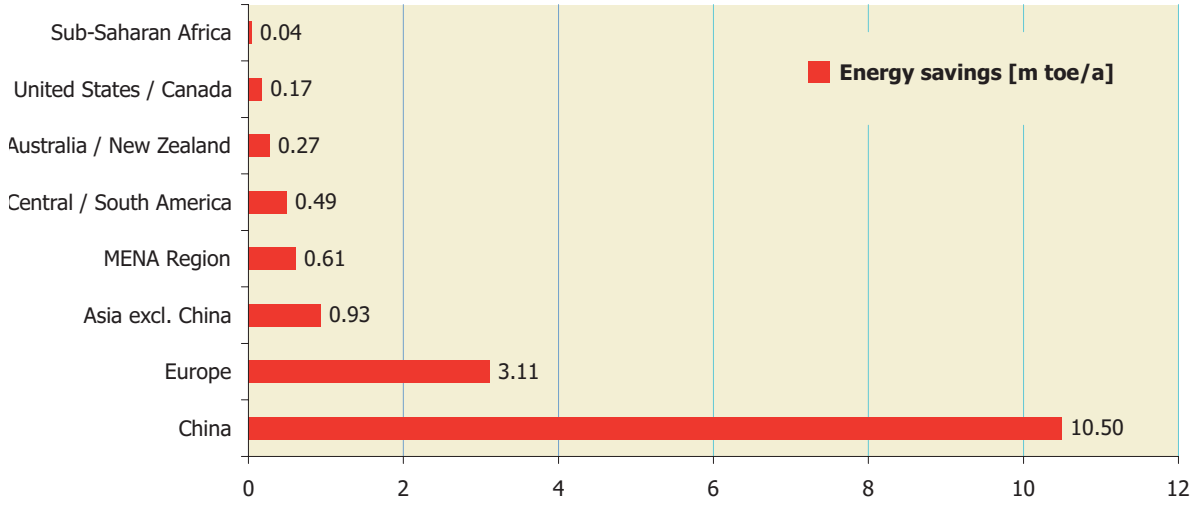


Figure 32: Contribution to CO_2 reduction by glazed (FPC + ETC) water collectors in operation by economic region in 2010

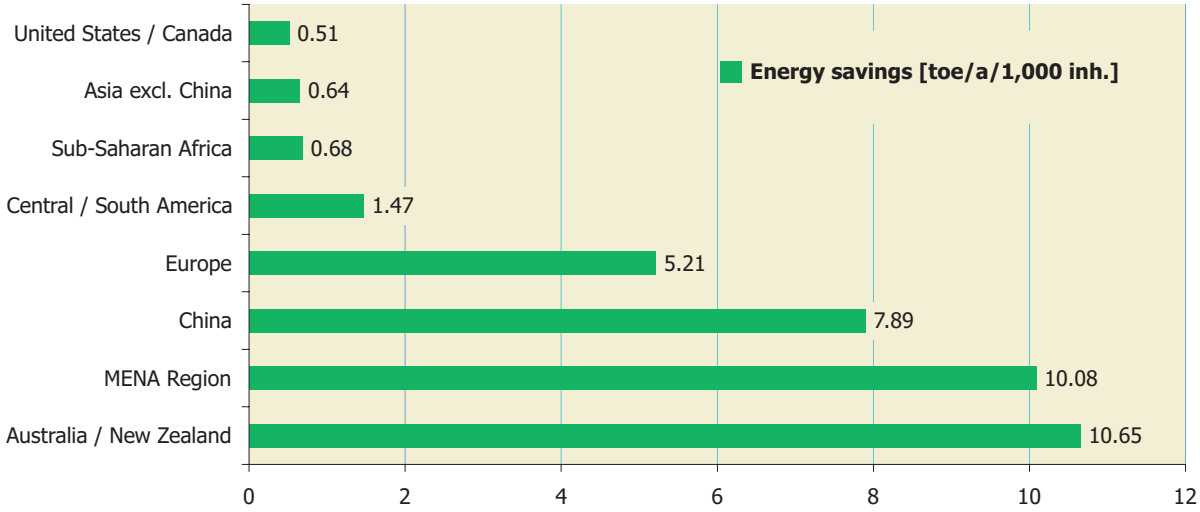


Figure 33: Contribution to CO_2 reduction by glazed (FPC + ETC) water collectors in operation by economic region per 1,000 inhabitants in 2010

Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

5.3.2 Annual CO_2 reduction by unglazed water collectors and economic region in 2010

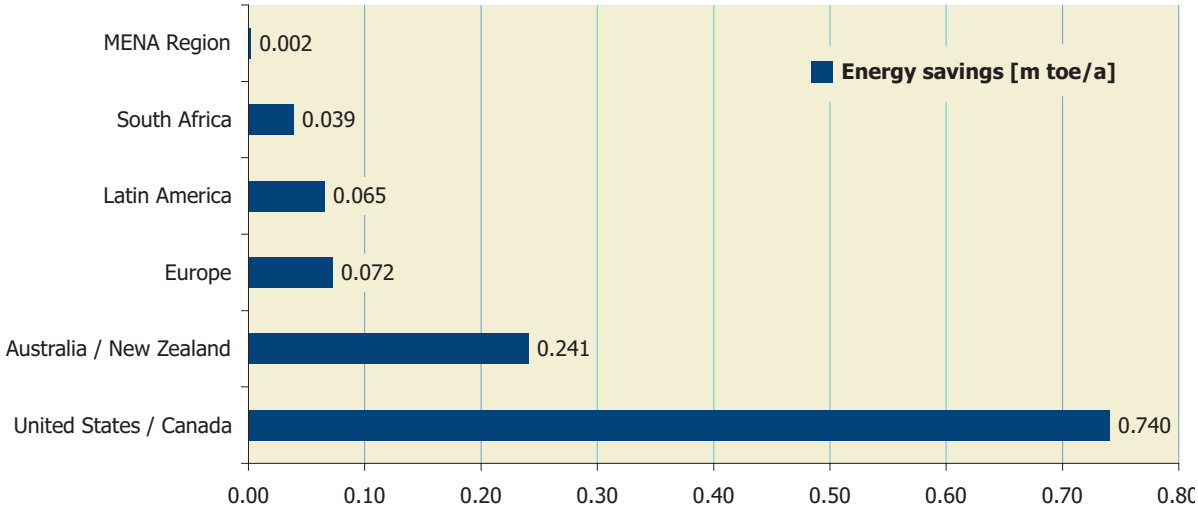


Figure 34: Contribution to CO_2 reduction by unglazed water collectors in operation by economic region in 2010

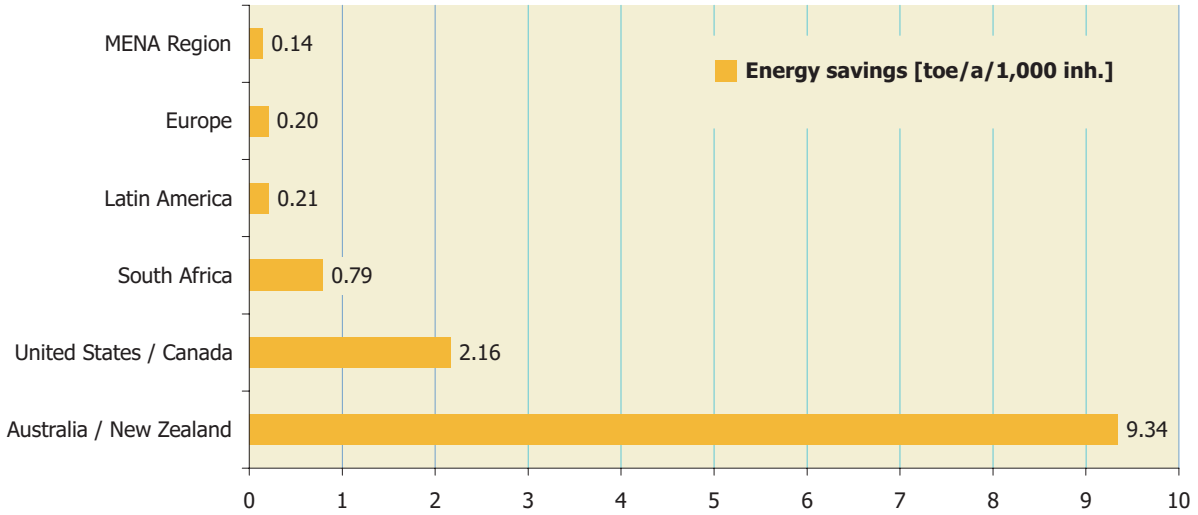


Figure 35: Contribution to CO_2 reduction by unglazed water collectors in operation by economic region per 1,000 inhabitants in 2010

Latin America:	Brazil, Mexico
Europe:	EU 16, Norway, Switzerland
MENA Region:	Israel, Jordan

6 Distribution of systems by system type and application

The thermal utilization of the energy from the sun greatly varies in different regions on Earth. It can be roughly distinguished between the type of solar thermal collector used, the way of system operation (pumped solar thermal system or thermosiphon systems) as well as the main application the energy gained from the sun is used for (hot water preparation, space heating, industrial processes, cooling).

In chapters 6.1 to 6.6, these system types and applications are shown by different economic regions for both the cumulated capacity in operation and the newly installed capacity in 2010. Finally in chapters 6.7 to 6.9, an overview on large scale solar heating and cooling applications in Europe and worldwide is given.

6.1 Distribution by type of solar thermal collector of the total installed capacity

Referring to the total water collector area, evacuated tube collectors dominated with a share of 57% of the cumulated capacity in operation (see **Figure 36**) and a share of 78% of the newly installed capacity (see **Figure 38**). Especially in China, vacuum tube collectors played an important role and since this was by far the largest market supported by high growth rates, the worldwide figures tend towards a higher share of this type of solar thermal collector.

Unglazed water collectors accounted for 11% of the cumulated water collectors installed worldwide (see **Figure 36**) and the share tended to decrease: in 2010 the share of unglazed water collectors was just slightly higher than 4% of the newly installed capacity (see **Figure 38**).

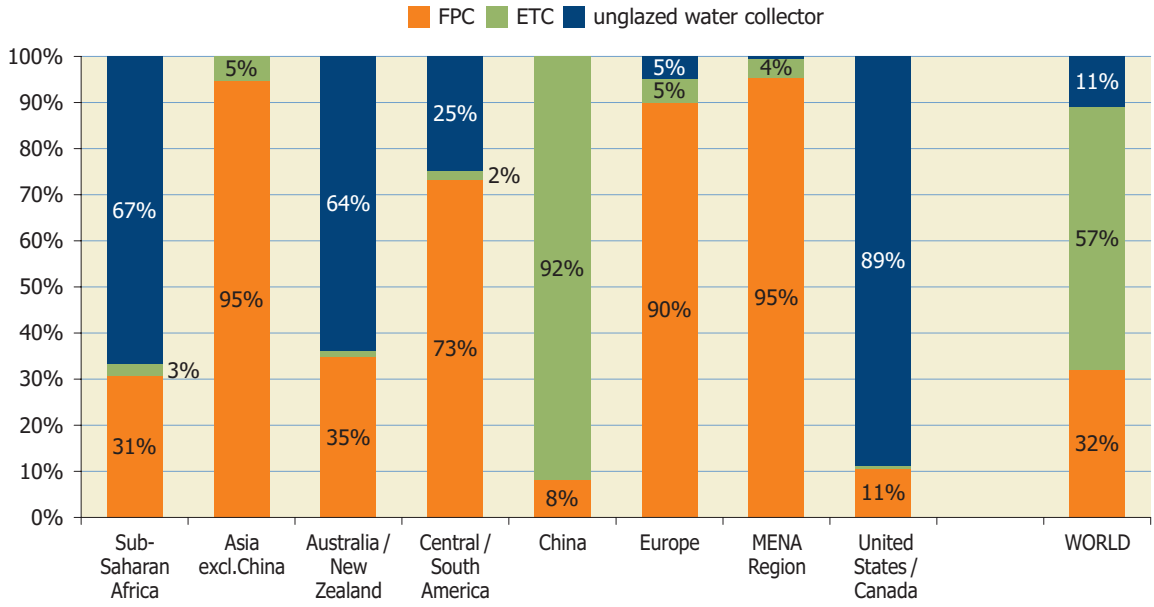


Figure 36: Distribution by type of solar thermal collector for the total installed water collector capacity in operation by the end of 2010

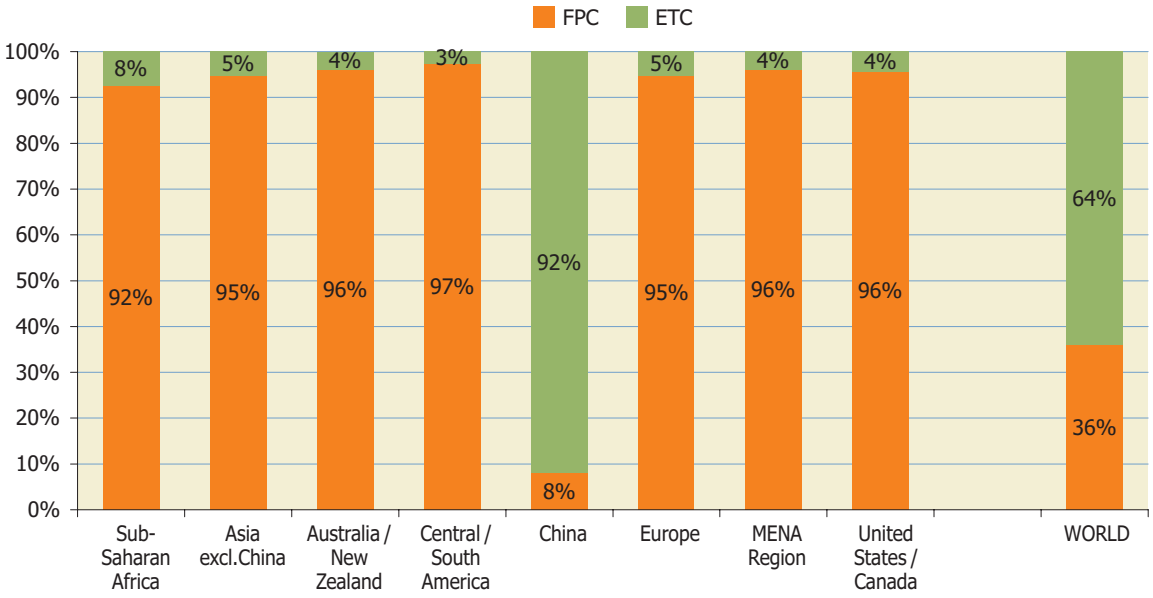


Figure 37: Distribution by type of solar thermal collector for the total installed glazed (FPC + ETC) water collector capacity in operation by the end of 2010

Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

6.2 Distribution by type of solar thermal collector of the newly installed capacity in 2010

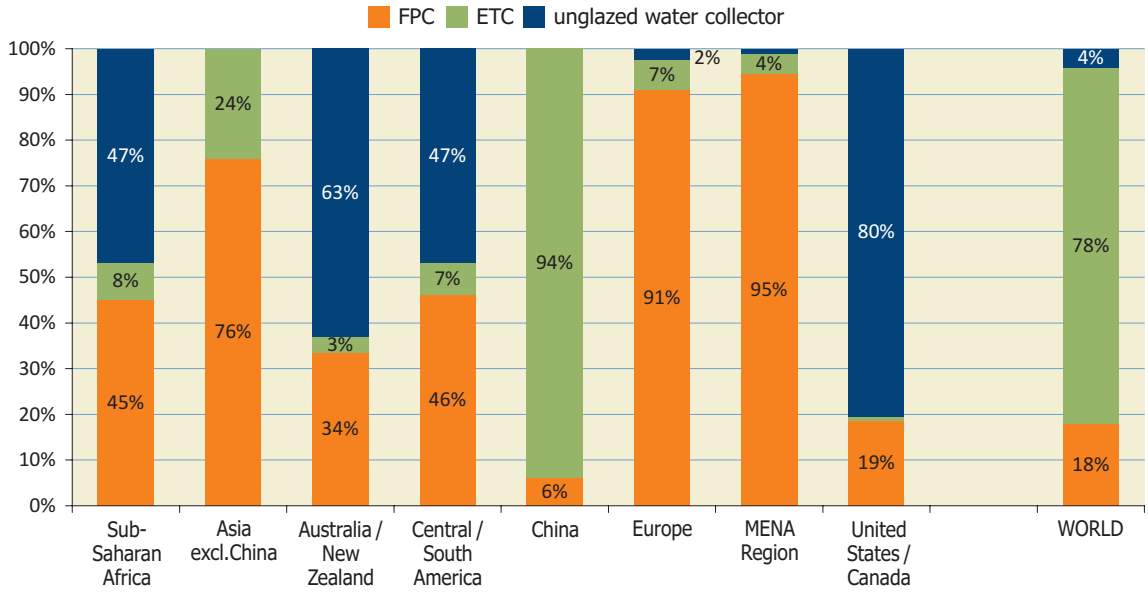


Figure 38: Distribution by type of solar thermal collector for the newly installed water collector capacity in 2010

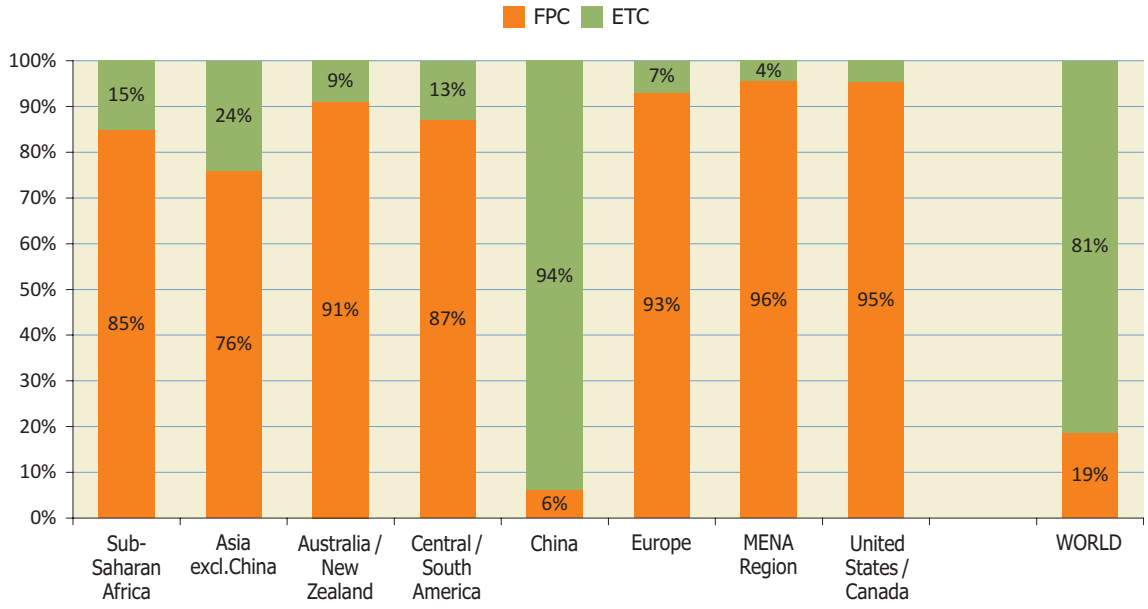


Figure 39: Distribution by type of solar thermal collector for the newly installed glazed (FPC + ETC) water collector capacity in 2010

Asia excluding China:	India, Japan, Korea South, Taiwan
Europe:	Albania, EU 27, Norway, Switzerland, Turkey
Latin America:	Brazil, Chile, Mexico
MENA Region:	Israel, Jordan, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

6.3 Distribution by type of system of the total installed capacity

Worldwide, about three quarters of all solar thermal systems installed are thermosiphon systems and the rest are pumped solar heating systems (see **Figure 40**). Similar to the distribution by type of solar thermal collector in total numbers the Chinese market influenced the overall figures most, and in 2010 89% of the newly installed systems were estimated to be thermosiphon systems while pumped systems only accounted for 11% (see **Figure 41**).

In general, thermosiphon systems are more common in warm climates such as in Africa, Latin America, South of 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.

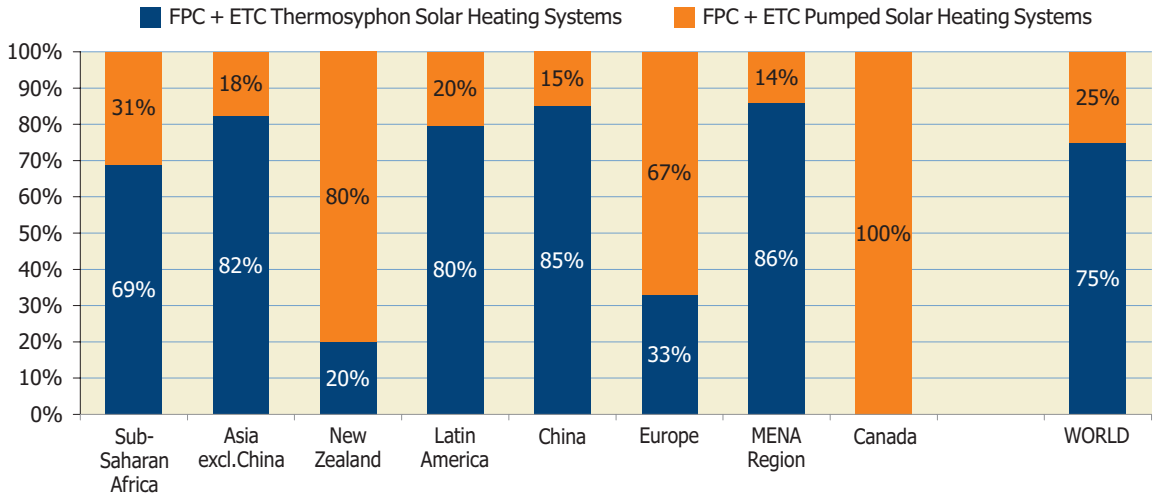


Figure 40: Distribution by type of system for the total installed water collector capacity in operation by the end of 2010

Asia excluding China:	Japan, Korea South, Taiwan	Europe:	Albania, EU 19, Norway, Switzerland, Turkey
Latin America:	Brazil, Chile	MENA Region:	Jordan, Tunisia
Sub-Saharan Africa:	Namibia, South Africa		

6.4 Distribution by type of system of the newly installed capacity in 2010

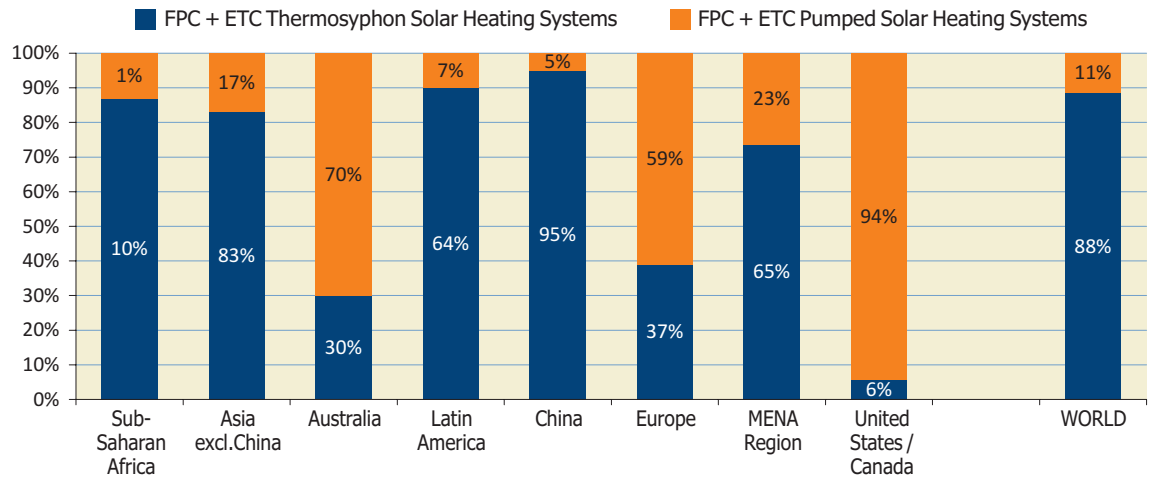


Figure 41: Distribution by type of system for the newly installed water collector capacity in 2010

Asia excluding China:	India, Japan, Korea South, Taiwan	Europe:	Albania, EU 21, Norway, Turkey
Latin America:	Brazil	MENA Region:	Jordan, Israel, Tunisia
Sub-Saharan Africa:	Namibia		

6.5 Distribution by application of the total installed capacity[5]

The calculated number of different types of solar thermal systems in operation exceeded 53 million by the end of 2010 (see **Table 5**). Worldwide, 85% of the overall capacity installed was used for domestic hot water preparation in single family houses and 10% were attached to larger domestic hot water consumers such as multifamily houses, hotels, hospitals, schools, homes for elderly people, etc. (see **Figure 42**).

The market for solar combi systems (systems that deliver energy for both domestic hot water and space heating) is well established in some mature European markets such as in Germany and Austria accounting for more than 40% in these local markets and for 4% in a worldwide context (see **Figure 43**).

Other applications such as solar supported district heating networks, solar process heat and solar air conditioning systems are at a very early stage of market penetration in a worldwide context amounting for less than 1% of the total installed capacity.

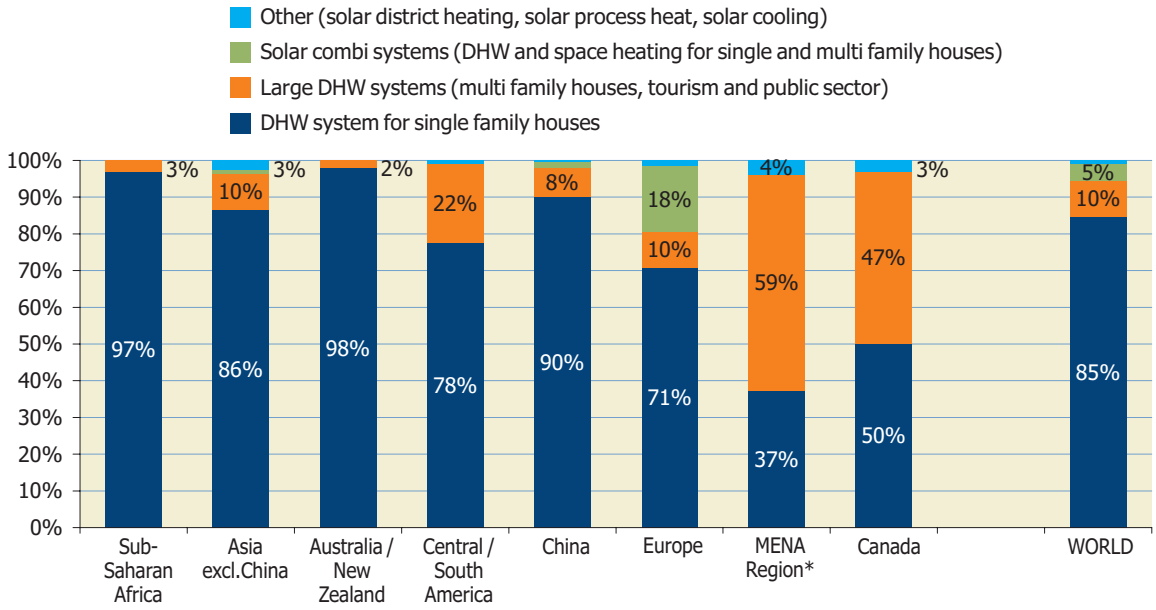


Figure 42: Distribution of solar thermal systems by application for the total installed glazed water collector capacity in operation by the end of 2010

DHW	Domestic hot water
Asia excluding China:	India, Japan, Korea South, Taiwan
Central / South America:	Barbados, Brazil, Chile, Mexico
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan
Sub-Saharan Africa:	Namibia, South Africa

5 In the MENA region (especially in Israel) but also in China, it is very common to equip multifamily houses with thermosiphon systems for domestic hot water preparation. A typical system is connected to one flat. By contrast in many European countries large pumped DHW systems in multifamily houses supply DHW or both DHW and space heating to the entire building. When interpreting the figures in chapter 6.5 this has to be considered.

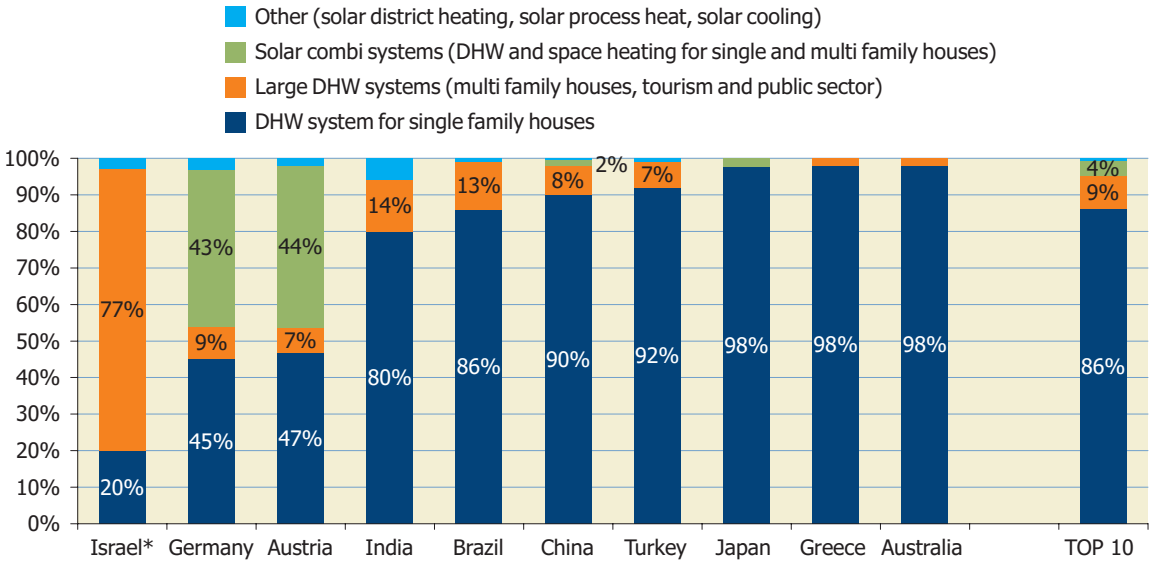


Figure 43: Distribution of solar thermal systems by application for the 10 leading markets of the total installed glazed water collector capacity in operation by the end of 2010

6.6 Distribution by application of the newly installed capacity in 2010[6]

For newly installed systems the trend is towards more sophisticated applications with regional focus areas as can be seen in **Figure 44**, **Figure 45** and **Figure 46**.

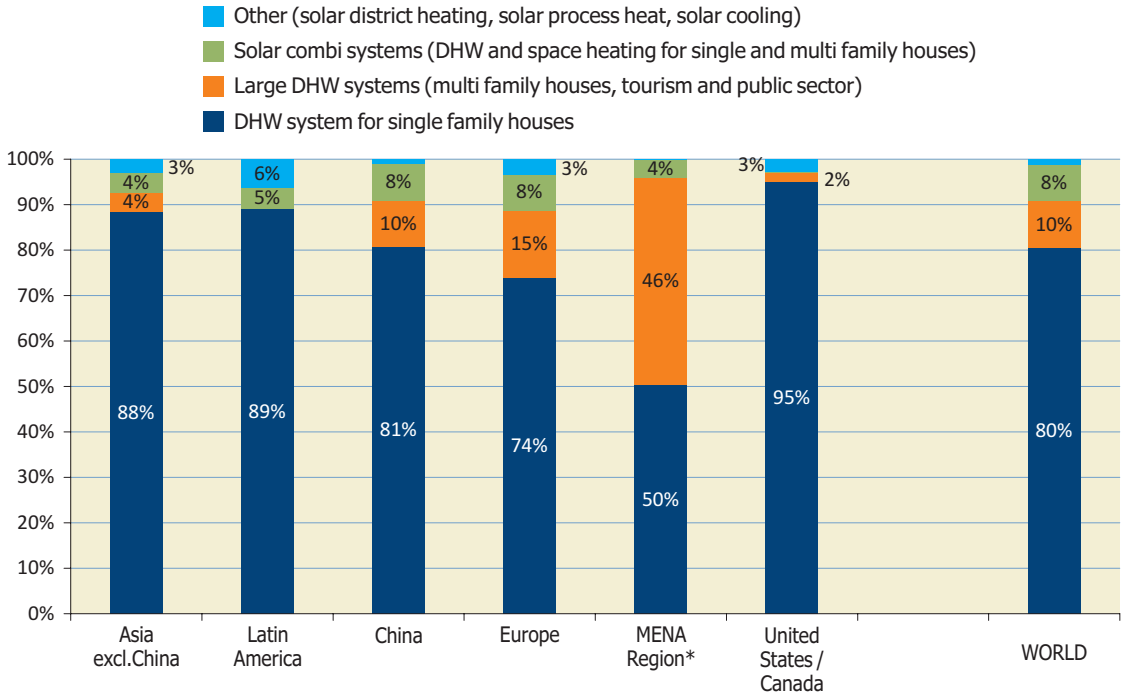


Figure 44: Distribution of different applications of the newly installed capacity of glazed water collectors by economic region in 2010

Sub-Saharan Africa:	no representative recordings
Asia excluding China:	India, Japan, Taiwan
Latin America:	Brazil, Mexico
Europe:	Albania, EU 17, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Tunisia

In several well-established markets in Europe as well as in some Latin American (Brazil, Mexico) and Asian (China, India, Japan) countries, the market penetration of solar combi-systems, solar supported district heating networks, industrial applications and solar cooling systems is increasing.

6 In the MENA region (especially in Israel) but also in China, it is very common to equip multifamily houses with thermosiphon systems for domestic hot water preparation. A typical system is connected to one flat. By contrast in many European countries large pumped DHW systems in multifamily houses supply DHW or both DHW and space heating to the entire building. When interpreting the figures in chapter 6.6 this has to be considered.

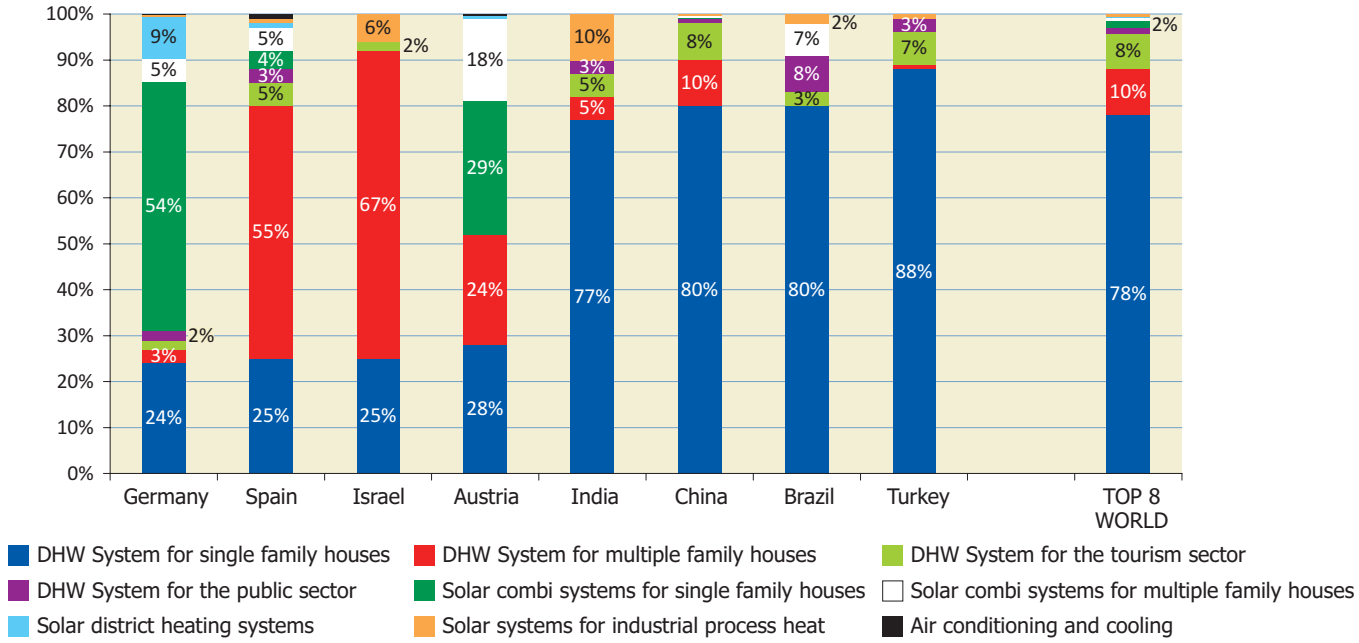


Figure 45: Distribution of different applications of the newly installed capacity of glazed water collectors for the 8 leading countries worldwide in 2010

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

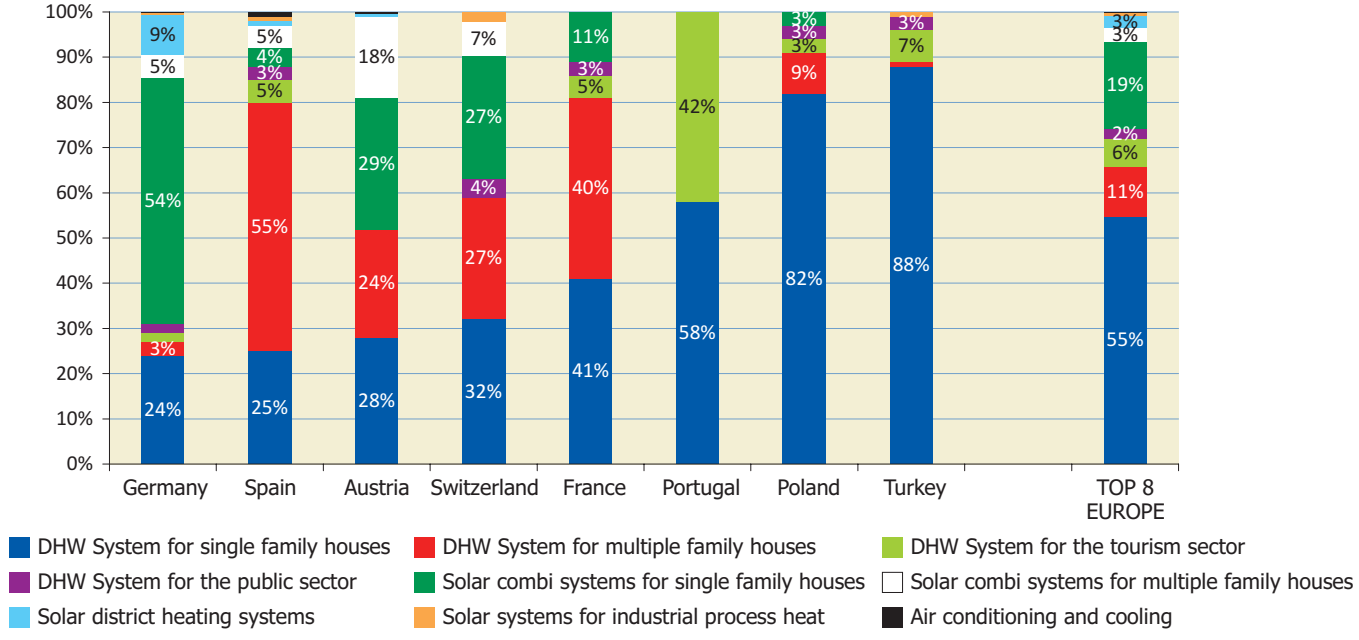


Figure 46: Distribution of different applications of the newly installed capacity of glazed water collectors for the 8 leading European countries in 2010

6.7 Worldwide large 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 in the past.

In July 2011, the world's largest solar thermal system was commissioned in Riyadh, Saudi Arabia. The solar thermal plant, with a total capacity of 25 MW_{th} (36.305 m²), is connected to a district heating network for the supply of space heating and domestic hot water of a university campus. Another successful solar supported heating network was implemented in Alberta, Canada. The Drake Landing community uses a 1.6 MW_{th} (2.293 m²) centralized solar thermal plant connected to a seasonal storage to supply more than 90% of the energy needed for space heating 52 detached energy efficient homes.

In Singapore, a large-scale solar thermal heating and cooling installation with a total capacity of 2.73 MW_{th} (3,900 m²) started operation in 2011 as well. The roof mounted solar thermal plant is connected to a 1.76 MW_{th} absorption chiller and supplies hot water and cooling to around 2,500 students, who live and study at a newly created 76,000 m² campus.

The largest solar process heat applications are installed in China and connected to dyeing and weaving mill factories. The first plant of 9.1 MW_{th} (13,000 m²) was constructed in the province of Zhejiang at Shaoxing Dyeing and Weaving Mill in Hangzhou and two other projects of 10.5 MW_{th} (15,000 m²) have been commissioned in the neighboring province of Jiangsu.

6.8 European large scale solar thermal applications

In the Scandinavian countries of Denmark and Sweden, but also in Germany, Austria, 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 2010, 149 large scale systems with a total installed capacity of 215 MW_{th} (307,300 m²) were in operation and more than 80 plants larger than 700 kW_{th} (or 1,000 m²) were reported in Europe.

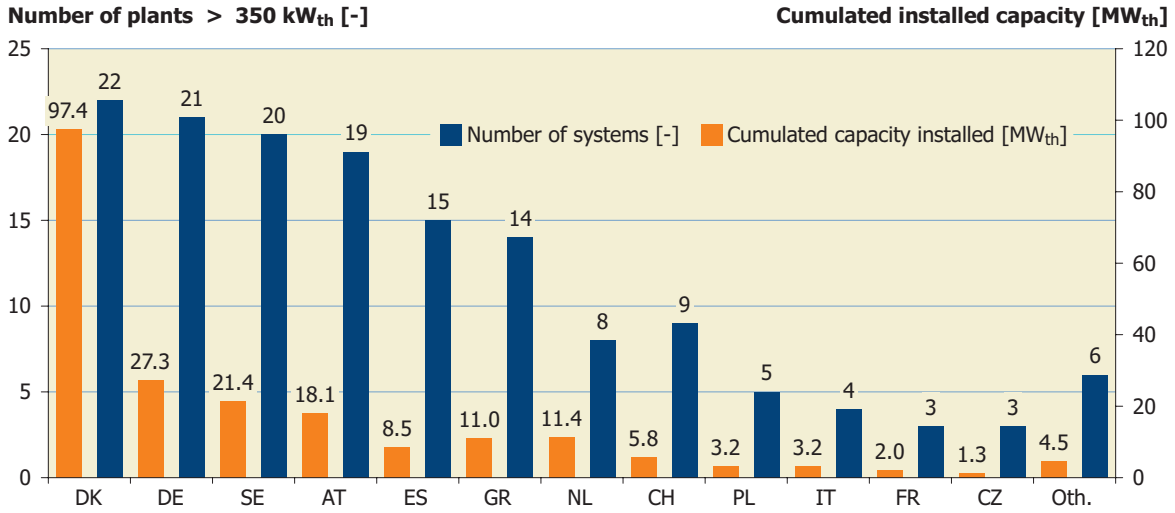


Figure 47: European large-scale solar heating plants by the end of 2010

(Source: Jan-Olof Dalenbäck - Chalmers University of Technology)

By end of 2011 the five largest European plants are installed in Denmark: Marstal (18,365 m²), Ringkøbing (15,000 m²), Sydfalster (12,094 m²), Sæby (11,921 m²) and Gram (10,073 m²). The market for solar supported district heating networks in Denmark has been booming for several years and is driven by high taxes for natural gas

and an energy supply system that is characterized by decentralization on the one hand and a high share of wind energy on the electricity production on the other hand. This together with the liberalized market mechanisms for electricity in Europe and very 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 plants in many cases (source: http://www.solar-district-heating.eu/).

6.9 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 2010 approximately 600 solar cooling systems were installed worldwide and the major markets were in Spain, Germany and Italy. The market still can be categorized as a niche market under development, but nevertheless the annual growth rates are high as can be seen in the following **Figure 48**.

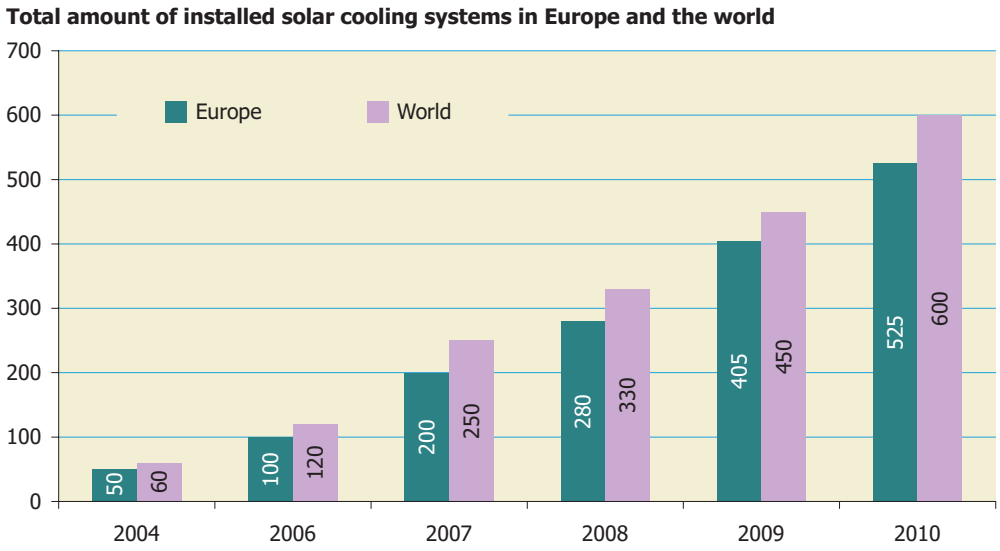


Figure 48: Market development of small to large-scale solar air conditioning and cooling systems worldwide as well as in Europe *(Source: Solem Consulting / Climasol, Fraunhofer ISE, Rococo, Tecsol)*

7 Appendix

7.1 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, flat-plate and evacuated tube collectors). Air collectors were not included.
- For each country, the cumulated water collector area was allocated to the following applications:
  - Solar thermal systems for swimming pool heating with unglazed water collectors,
  - 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)
  - Solar combi systems[7] for domestic hot water and space heating for single- and multifamily houses.
- Reference systems were defined for each country and for each type of application.
- The number of plants per country was determined from the share of collector area for each application and the collector area defined for the reference system.

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

Finally the annual collector yield per square meter of collector area, depending on the application, the local climatic conditions and the plant dimensions (high or low solar fraction) were calculated for each country and each system.

The amount of energy saved considering the utilization rate of the auxiliary heating system[8] is expressed in tons of oil equivalent (toe): 1 toe = 11,630 kWh.

The CO_2 emissions avoided by the different solar thermal applications were ascertained from the energy savings (oil equivalent): 1 toe = 3.1 t_{CO2}[9]

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 the energy source for the auxiliary heating system instead of oil.

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.

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

8 For the swimming pool applications a utilization rate of 0.9 is assumed in the calculation and for all other applications an average utilization rate of 0.8 is used.

9 Only direct emissions for fuel oil are considered referring to GEMIS database, version 4.6

7.1.1 Solar thermal systems for swimming pool heating with unglazed collectors

Country	Reference climate	Collector area (gross area) for single system [m²]	Total collector area unglazed 2010 [m²]	Total number of systems unglazed 2010 [-]
Australia	Sydney	34	5.400.000	158.824
Austria	Graz	200	599.491	2.997
Belgium	Brussels	200	46.875	234
Brazil	Brasília	200	1.277.128	6.386
Canada	Montreal	200	656.485	3.282
Cyprus	Nicosia	200	3.363	17
Czech Republic	Prague	200	150.000	750
Denmark	Copenhagen	200	20.515	103
762 Finland	Helsinki	200	11.779	59
France incl. DOM	Paris	200	89.181	446
Germany	Wurzburg	200	637.010	3.185
Hungary	Budapest	200	8.088	40
Ireland	Dublin	200	421	2
Israel	Jerusalem	200	29.900	150
Italy	Bologna	200	43.766	219
Jordan	Amman	200	5.940	30
Mexico	Mexico City	200	662.092	3.310
Netherlands	Amsterdam	200	396.410	1.982
New Zealand	Wellington	200	7.025	35
Norway	Oslo	200	2.011	10
Portugal	Lisbon	200	2.435	12
South Africa	Johannesburg	200	803.678	4.018
Spain	Madrid	200	122.000	610
Sweden	Gothenburg	200	140.000	700
Switzerland	Zürich	200	212.850	1.064
Taiwan	Taipei	200	85	0
United States	LA, Indianapolis	200	19.361.098	96.805
Total			30.689.627	285.272

* Countries not listed in this table means that there was no reliable database for unglazed collectors available

Table 8: Solar thermal swimming pool heating reference systems with unglazed water collectors and the total collector area in operation by the end of 2010

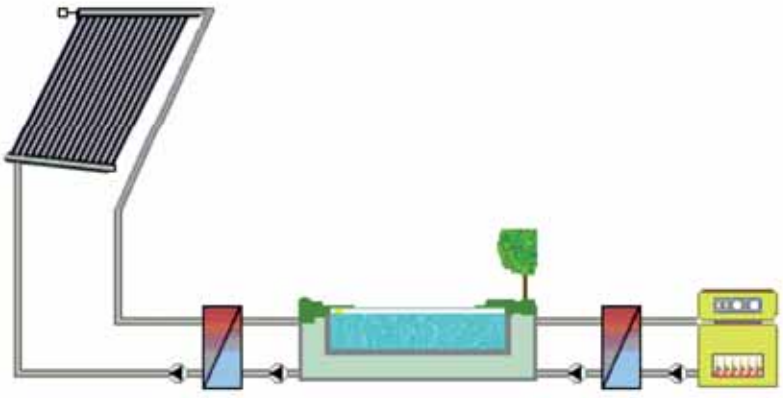


Figure 49: Hydraulic scheme of the swimming pool reference system

7.1.2 Solar domestic hot water systems for single-family houses

The market share in the following table refers to the total capacity in operation of glazed water collectors (FPC + ETC) by the end of 2010 for each country. It must be pointed out that the market share of the new installed capacity in the year 2010 can differ significantly from the total market share.

Country	Reference climate	Collector area (gross area) for single sys. [m²]	Total collector area-SFH 2010 [m²]	Share of DHW-SFH [%]	Total number of systems SFH 2010 [-]	Type of system [-]
Albania	Tirana	2,5	22.543	29%	9.017	TS
Australia	Sydney	6,0	2.857.251	98%	476.209	PS
Austria	Graz	6,0	1.858.739	47%	309.790	PS
Barbados	Grantley Adams	4,0	131.690	100%	32.923	TS
Belgium	Brussels	4,0	316.634	100%	79.159	PDS
Brazil	Brasília	4,0	4.157.540	86%	1.039.385	TS
Bulgaria	Sofia	4,0	33.306	71%	8.327	PS
Canada	Montreal	6,0	33.107	50%	5.518	PS
Chile	Santiago de Chile	4,0	12.953	46%	3.238	PS
China	Shanghai	4,0	151.200.000	90%	37.800.000	TS
Cyprus	Nicosia	4,0	786.811	87%	196.703	TS
Czech Republic	Prague	6,0	178.605	58%	29.767	PS
Denmark	Copenhagen	4,0	455.708	86%	113.927	PS
Estonia	Tallinn	4,0	2.841	100%	710	PS
Finland	Helsinki	4,0	32.738	95%	8.184	PS
France incl. DOM	Paris	4,0	1.645.272	75%	411.318	PS
Germany	Wurzburg	6,0	5.887.419	45%	981.237	PS
Greece	Athens	2,5	4.005.260	98%	1.602.104	TS
Hungary	Budapest	6,0	74.907	50%	12.485	PS
India	Delhi	4,0	3.176.000	80%	794.000	TS
Ireland	Dublin	4,0	136.059	90%	34.015	PS
Israel	Jerusalem	4,0	827.579	20%	206.895	TS
Italy	Bologna	4,0	2.547.578	100%	636.895	PS
Japan	Tokyo	4,0	5.175.606	98%	1.293.901	TS
Jordan	Amman	4,0	790.050	80%	197.512	TS
Korea, South	Seoul	4,0	845.812	54%	211.453	PS
Latvia	Riga	4,0	7.244	100%	1.811	PS
Lebanon	Beirut	4,0	348.312	100%	87.078	TS
Lithuania	Vilnius	4,0	4.518	100%	1.130	PS
Luxembourg	Luxembourg	4,0	30.800	100%	7.700	PS
Macedonia	Skopje	4,0	12.100	47%	3.025	PS
Malta	Luqa	4,0	43.469	100%	10.867	PS
Mexico	Mexico City	4,0	243.561	28%	60.890	PS
Morocco	Rabat	4,0	341.260	100%	85.315	TS
Namibia	Windhoek	4,0	9.903	45%	2.476	TS
Netherlands	Amsterdam	3,0	331.857	80%	110.619	PDS
New Zealand	Wellington	4,0	144.989	95%	36.247	PS
Norway	Oslo	6,0	15.151	98%	2.525	PS
Poland	Warsaw	6,0	459.060	70%	76.510	PS
Portugal	Lisbon	4,0	525.951	70%	131.488	PS
Romania	Bucharest	4,0	109.996	100%	27.499	PS
Slovakia	Bratislava	6,0	135.746	100%	22.624	PS
Slovenia	Ljubljana	6,0	135.869	83%	22.645	PS
South Africa	Johannesburg	4,0	359.682	100%	89.920	TS
Spain	Madrid	4,0	818.300	35%	204.575	PS
Sweden	Gothenburg	6,0	30.200	10%	5.033	PS
Switzerland	Zürich	6,0	532.824	67%	88.804	PS
Taiwan	Taipei	4,0	1.933.245	95%	483.311	TS
Thailand	Bangkok	4,0	91.392	100%	22.848	TS
Tunisia	Tunis	4,0	475.009	97%	118.752	TS
Turkey	Ankara	4,0	12.253.166	92%	3.063.292	TS
United Kingdom	London	4,0	564.783	100%	141.196	PS
United States	LA, Indianapolis	6,0	2.446.342	100%	407.724	PS
Uruguay	Montevideo	4,0	12.096	100%	3.024	PS
Zimbabwe	Harare	4,0	18.196	100%	4.549	PS
Total			209.627.029	85%	51.818.147	

DHW-SFH: domestic hot water systems
TS: thermosiphon system
Auxiliary heating device: oil boiler

PS: pumped system for single-family houses
PDS: pumped drain back system

Table 9: Domestic hot water reference systems for single family houses and the total collector area in operation by the end of 2010

Figure 50 shows the hydraulic scheme used for the energy calculation for all pumped solar thermal systems and **Figure 51** refers to the thermosiphon systems.

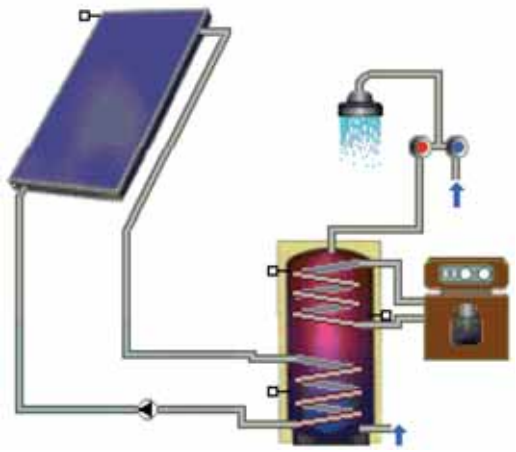


Figure 50: Hydraulic scheme of the DHW pumped reference system

Figure 51: Hydraulic scheme of the DHW thermosiphon reference system

For the Chinese thermosiphon systems, the above reference system was used but instead of a flat plate collector as shown in **Figure 51** a representative Chinese vacuum tube collector was used for the simulation.

7.1.3 Solar domestic hot water systems for multifamily houses, hotels and district heating

The market share shown in **Table 10** refers to the total capacity in operation of flat plate and evacuated tube collectors by the end of 2010 for each country. It must be pointed out that the market share of the newly installed capacity in the year 2010 can differ greatly from the total market share.

Country	Reference climate	Collector area (gross area) for single sys. [m²]	Total collector area-MFH 2010 [m²]	Share of DHW-MFH [%]	Total number of systems SFH 2010 [-]	Type of System [-]
Albania	Tirana	2,5	55.190	71,0%	22.076	PS
Australia	Sydney	6,0	58.311	2,0%	9.719	PS
Austria	Graz	6,0	346.678	8,8%	57.780	PS
Brazil	Brasília	4,0	676.809	14,0%	169.202	PS
Bulgaria	Sofia	4,0	13.430	28,7%	3.357	PS
Canada	Montreal	6,0	33.107	50,0%	5.518	PS
Chile	Santiago de Chile	4,0	15.206	54,0%	3.801	PS
China	Shanghai	4,0	14.280.000	8,5%	3.570.000	PS
Cyprus	Nicosia	4,0	104.123	11,5%	26.031	PS
Czech Republic	Prague	6,0	9.238	3,0%	1.540	PS
Denmark	Copenhagen	4,0	68.886	13,0%	17.222	PS
Finland	Helsinki	4,0	1.723	5,0%	431	PS
France incl. DOM	Paris	4,0	219.370	10,0%	54.842	PS
Germany	Wurzburg	6,0	1.596.145	12,2%	266.024	PS
Greece	Athens	2,5	81.740	2,0%	32.696	PS
Hungary	Budapest	6,0	47.940	32,0%	7.990	PS
India	Delhi	4,0	794.000	20,0%	198.500	PS
Ireland	Dublin	4,0	4.535	3,0%	1.134	PS
Israel	Jerusalem	4,0	3.310.316	80,0%	827.579	PS
Japan	Tokyo	4,0	6.578	0,1%	1.645	PS
Jordan	Amman	4,0	197.512	20,0%	49.378	PS
Korea, South	Seoul	4,0	720.507	46,0%	180.127	PS
Macedonia	Skopje	4,0	13.644	53,0%	3.411	PS
Mexico	Mexico City	4,0	626.301	72,0%	156.575	PS
Namibia	Windhoek	4,0	12.103	55,0%	3.026	PS
Netherlands	Amsterdam	3,0	62.223	15,0%	20.741	PS
New Zealand	Wellington	4,0	7.631	5,0%	1.908	PS
Norway	Oslo	6,0	155	1,0%	26	PS
Poland	Warsaw	6,0	163.950	25,0%	27.325	PS
Portugal	Lisbon	4,0	225.407	30,0%	56.352	PS
Slovenia	Ljubljana	6,0	3.274	2,0%	546	PS
Spain	Madrid	4,0	1.309.280	56,0%	327.320	PS
Sweden	Gothenburg	6,0	45.300	15,0%	7.550	PS
Switzerland	Zürich	6,0	63.621	8,0%	10.603	PS
Taiwan	Taipei	4,0	112.517	5,5%	28.129	PS
Tunisia	Tunis	4,0	14.691	3,0%	3.673	PS
Turkey	Ankara	4,0	1.065.493	8,0%	266.373	PS
Total			26.366.936	11%	6.420.149	

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

Table 10: Domestic hot water reference systems for multifamily houses, hotels and district heating and the total collector area in operation in 2010

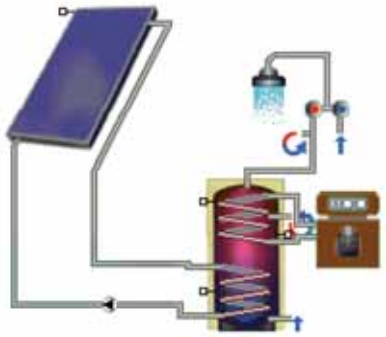


Figure 52: Hydraulic scheme of the DHW system for multifamily houses

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

The market share of combi-systems in the following table refers to the total capacity in operation of flat-plate and evacuated tube collectors at the end of 2009 for each country. It must be pointed out that the market share of the new installed capacity in the year 2009 can differ significantly from the total market share. The reference system is designed for a single-family house with a 140 m² heated floor area.

Country	Reference climate	Collector area (gross area) for single sys. [m²]	Total collector area-combi sys. 2010 [m²]	Share of combi systems [%]	Total number of systems SFH 2010 [-]	Type of system [-]
Austria	Graz	16,0	1.753.370	47,0%	109.586	PS
China	Shanghai	12,0	2.520.000	90,0%	210.000	PS
Cyprus	Nicosia	12,0	14.487	86,9%	1.207	PS
Czech Republic	Prague	12,0	120.096	58,0%	10.008	PS
Denmark	Copenhagen	12,0	5.299	86,0%	442	PS
France incl. DOM	Paris	15,0	329.054	75,0%	21.937	PS
Germany	Wurzburg	12,0	5.599.590	45,0%	466.632	PS
Hungary	Budapest	12,0	26.967	50,0%	2.247	PS
Ireland	Dublin	12,0	10.582	90,0%	882	PS
Japan	Tokyo	12,0	118.799	97,6%	9.900	PS
Netherlands	Amsterdam	6,0	20.741	80,0%	3.457	PS
Norway	Oslo	12,0	155	98,0%	13	PS
Poland	Warsaw	12,0	32.790	70,0%	2.733	PS
Slovenia	Ljubljana	12,0	24.555	83,0%	2.046	PS
Spain	Madrid	12,0	210.420	35,0%	17.535	PS
Sweden	Gothenburg	12,0	226.500	10,0%	18.875	PS
Switzerland	Zürich	12,0	198.815	67,0%	16.568	PS
Total			11.212.219	4,5%	894.067	

combi-system: system for the supply of domestic hot water and space heating
PS: pumped system

Table 11: Solar combi reference systems for single and multifamily houses and the total collector area in operation in 2010

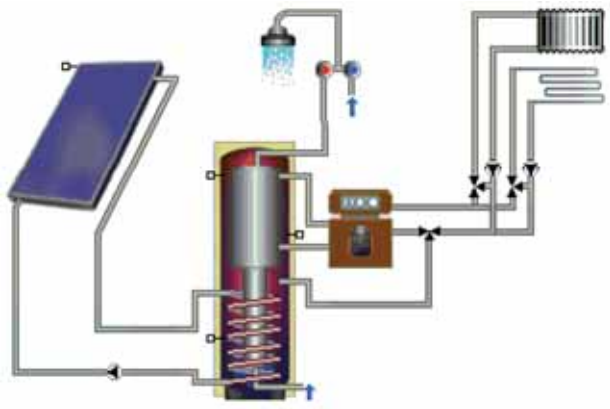


Figure 53: Hydraulic scheme of the solar combi reference system

7.2 Reference collectors

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

$\eta = 0.85$
$a_1 = 20$ [W/m²K]
$a_2 = 0.1$ [W/m² K²]

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

$\eta = 0.8$
$a_1 = 3.69$ [W/m²K]
$a_2 = 0.007$ [W/m² K²]

7.2.3 Data of the Chinese reference vacuum tube collector

$\eta = 0.74$
$a_1 = 2.5$ [W/m²K]
$a_2 = 0.013$ [W/m² K²]

7.3 Reference climates

Country	Reference climate	Horizontal irradiation [kWh/m²·a]	Inclined irradiation [kWh/m²·a]	Avg. Outside air temp. [°C]
Albania	Tirana	1.604	1.835	13,5
Australia	Sydney	1.674	1.841	18,1
Austria	Graz	1.126	1.280	9,2
Barbados	Grantley Adams	2.016	2.048	27,4
Belgium	Brussels	971	1.095	10,0
Brazil	Brasília	1.793	1.838	22,0
Bulgaria	Sofia	1.188	1.304	10,1
Canada	Montreal	1.351	1.568	6,9
Chile	Santiago de Chile	1.753	1.850	14,5
China	Shanghai	1.282	1.343	17,1
Cyprus	Nicosia	1.886	2.098	19,9
Czech Republic	Prague	998	1.111	7,9
Denmark	Copenhagen	989	1.164	8,1
Estonia	Tallinn	960	1.126	5,3
Finland	Helsinki	948	1.134	4,6
France incl. DOM	Paris	1.112	1.246	11,0
Germany	Wurzburg	1.091	1.225	9,5
Greece	Athens	1.585	1.744	18,5
Hungary	Budapest	1.199	1.346	11,0
India	Delhi	1.961	2.275	24,7
Ireland	Dublin	949	1.091	9,5
Israel	Jerusalem	2.198	2.400	17,3
Italy	Bologna	1.419	1.592	14,3
Japan	Tokyo	1.175	1.287	16,7
Jordan	Amman	2.145	2.341	17,9
Korea, South	Seoul	1.161	1.280	12,7
Latvia	Riga	991	1.187	6,3
Lebanon	Beirut	1.935	2.132	19,9
Lithuania	Vilnius	1.001	1.161	6,2
Luxembourg	Luxembourg	1.037	1.158	8,4
Macedonia	Skopje	1.381	1.521	12,5
Malta	Luqa	1.902	2.115	18,7
Mexico	Mexico City	1.706	1.759	16,6
Morocco	Rabat	2.011	2.281	17,8
Namibia	Windhoek	2.363	2.499	21,0
Netherlands	Amsterdam	999	1.131	10,0
New Zealand	Wellington	1.401	1.542	13,6
Norway	Oslo	971	1.208	5,8
Poland	Warsaw	1.024	1.156	8,1
Portugal	Lisbon	1.686	1.875	17,4
Romania	Bucharest	1.324	1.473	10,6
Slovakia	Bratislava	1.214	1.374	10,3
Slovenia	Ljubljana	1.115	1.231	9,8
South Africa	Johannesburg	2.075	2.232	15,6
Spain	Madrid	1.644	1.844	15,5
Sweden	Gothenburg	934	1.105	7,2
Switzerland	Zürich	1.094	1.218	9,6
Taiwan	Taipei	1.372	1.398	20,8
Thailand	Bangkok	1.765	1.898	29,1
Tunisia	Tunis	1.808	2.038	19,3
Turkey	Ankara	1.701	1.886	12,0
United Kingdom	London	943	1.062	12,0
United States	LA, Indianapolis	1.646	1.816	14,3
Uruguay	Montevideo	1.534	1.647	15,9
Zimbabwe	Harare	2.017	2.087	18,9

Table 12: Reference climates for the 55 countries surveyed

7.4 Population data

Country	2010
Albania	2.986.952
Australia	21.515.754
Austria	8.214.160
Barbados	285.653
Belgium	10.423.493
Brazil	201.103.330
Bulgaria	7.148.785
Canada	33.759.742
Chile	16.746.491
China	1.330.141.295
Cyprus	1.102.677
Czech Republic	10.201.707
Denmark	5.515.575
Estonia	1.291.170
Finland	5.255.068
France	64.768.389
Germany	81.644.454
Greece	10.749.943
Hungary	9.992.339
India	1.173.108.018

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

Table 13: Inhabitants by the end of 2010 of the 55 surveyed countries in alphabetical order

Region	Σ Inhabitants	Share
Sub-Saharan Africa	62.889.436	1,5%
Asia excluding China	1.438.684.445	34,3%
Australia / New Zealand	25.768.031	0,6%
Central / South America	333.905.405	8,0%
China	1.330.141.295	31,7%
Europe	596.644.621	14,2%
MENA Region	60.038.786	1,4%
United States / Canada	342.041.795	8,2%
TOTAL	4.190.113.814	100,0%

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

Asia excluding China:	India, Japan, Korea South, Taiwan, Thailand
Central / South America:	Barbados, Brazil, Chile, Mexico, Uruguay
Europe:	Albania, EU 27, Macedonia, Norway, Switzerland, Turkey
MENA Region:	Israel, Jordan, Lebanon, Morocco, Tunisia
Sub-Saharan Africa:	Namibia, South Africa, Zimbabwe

Table 14: Inhabitants per economic region by the end of 2010

7.5 Market data of the previous years

The data presented in Chapters 3 through 5 were originally collected in square meters. Through an agreement of international experts the collector areas of these solar thermal applications have been converted and are shown in installed capacity 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 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 2012 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 15**, **Table 16** and **Table 17** these countries are highlighted accordingly and in chapter 7.6 (references) the new data source is cited.

Country	Water Collectors			Air Collectors		TOTAL [m²]
	unglazed	FPC	ETC	unglazed	glazed	
Albania		9.740	104			9.844
Australia	600.000	277.000	14.000			891.000
Austria	15.220	343.617	4.086			362.923
Barbados		7.051	0			7.051
Belgium		82.000	9.000			91.000
Brazil	278.910	392.246				671.156
Bulgaria		4.000				4.000
Canada	89.577	13.173	1.083	34.135	1.191	139.159
Chile		7.094				7.094
China		1.240.000	29.760.000			31.000.000
Cyprus		40.290	1.000			41.290
Czech Republic		26.500	8.500			35.000
Denmark		31.000	2.000			33.000
Estonia		500				500
Finland	270	3.905	650			4.825
France incl. DOM*		372.000	16.000			388.000
lphaGermany		1.900.000	200.000		6.900	2.106.900
Greece		293.500	4.500			298.000
Hungary		8.500	2.500			11.000
India		463.487	23.174			486.662
Ireland		31.727	11.883			43.610
Israel	2.500	278.000				280.500
Italy		428.571	71.429			500.000
Japan		205.622	1.946		13.386	220.954
Jordan		20.041	30.062			50.103
Korea, South		51.552				51.552
Latvia		1.800				1.800
Lebanon		39.108				39.108
Lithuania		840				840
Luxembourg		2.800	800			3.600
Macedonia		3.866	554			4.420
Malta		6.000				6.000
Mexico	49.690	115.943				165.633
Morocco		42.000				42.000
Namibia		3.952	203			4.154
oNetherlands	28.216	23.414				51.630
New Zealand	600	20.379				20.979
Norway	180	1.030	210			1.420
Poland		89.820	39.812			129.632
Portugal	802	78.858	7.160			86.820
Romania		8.000				8.000
Slovakia		12.000	1.500			13.500
Slovenia		14.000	2.500			16.500
South Africa*	73.000	30.921	2.079			106.000
Spain	32.000	409.000	25.000			466.000
Sweden	28.648	14.530	12.283			55.461
Switzerland	9.374	104.040	8.793	7.000		129.207
Taiwan	330	105.683	11.751			117.764
Thailand		9.939				9.939
Tunisia		75.000	5.000			80.000
Turkey*		1.590.300				1.590.300
United Kingdom		47.250	33.750			81.000
United States	1.125.771	175.272	28.194	0	2.249	1.331.486
Uruguay		4.213				4.213
Zimbabwe		336	24			360
TOTAL	2.335.088	9.561.410	30.341.530	41.135	23.727	42.302.890

*revised due to new / adapted database in 2012

Table 15: Newly installed collector area in 2008 [m²/a]

Country	Water Collectors			Air Collectors		TOTAL [m²]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		10.035	116			10.151
Australia	620.000	483.019	36.356			1.139.375
Austria	8.342	348.408	7.759	378		364.886
Barbados		7.051				7.051
Belgium		45.500	5.200			50.700
Brazil	407.051	391.089				798.140
Bulgaria		8.000				8.000
Canada	73.026	9.186	1.083	45.331	792	129.418
Chile*		7.516				7.516
China		2.000.000	40.000.000			42.000.000
Cyprus		53.000	2.000			55.000
Czech Republic		30.000	10.000			40.000
Denmark		52.000	2.500			54.500
Estonia		60	390			450
Finland		2.800	1.200			4.000
France incl. DOM*		324.000	11.000			335.000
Germany		1.430.000	185.000			1.615.000
Greece		204.500	1.500			206.000
Hungary	3.000	14.000	8.000	500	200	25.700
India		376.505	173.495			550.000
Ireland		26.383	16.131			42.514
Israel*	2.950	291.900				294.850
Italy*		415.625	59.375			475.000
Japan		139.821	1.682		12.110	153.613
Jordan		30.435	9.091			39.526
Korea, South*		96.951				96.951
Latvia		40	140			180
Lebanon		18.967	28.451			47.418
Lithuania		50	150			200
Luxembourg		3.650	1.050			4.700
Macedonia		3.002			4	3.006
Malta		4.386	4.122			8.508
Mexico	75.501	82.002	70.430		5.403	233.336
Morocco		40.968				40.968
Namibia		3.979	244			4.224
Netherlands	28.814	45.260				74.074
New Zealand	481	24.614				25.095
Norway	270	1.680	210			2.160
Poland		106.494	37.814			144.308
Portugal	1.500	130.000	13.500			145.000
Romania		11.000	9.000			20.000
Slovakia		11.600	1.900			13.500
Slovenia		17.000	5.000			22.000
South Africa*	50.000	34.710	4.290			89.000
Spain	11.000	375.000	16.000			402.000
Sweden	24.993	13.126	8.183			46.302
Switzerland	12.057	135.355	10.285	11.000		168.697
Taiwan		104.214	12.305			116.519
Thailand		14.650				14.650
Tunisia		70.188	14.812			85.000
Turkey*		1.633.050				1.633.050
United Kingdom		51.975	37.125			89.100
United States	856.517	159.471	26.728		1.793	1.044.509
Uruguay		7.235				7.235
Zimbabwe		217	138			355
TOTAL	2.175.502	9.901.667	40.833.754	57.209	20.302	52.988.434

*revised due to new / adapted database in 2012

Table 16: Newly installed collector area in 2009 [m²/a]

Country	Water Collectors			Air Collectors		TOTAL [m²]
	unglazed	glazed	evacuated tube	unglazed	glazed	
Albania		69.705,0	466,0			70.171
Australia	4.720.000,0	2.443.568,9	73.806,1			7.237.375
Austria	616.952,0	3.634.012,4	54.827,5	378,0		4.306.170
Barbados		131.690,0				131.690
Belgium	46.874,9	252.620,0	25.713,3			325.208
Brazil*	783.403,0	4.392.993,0				5.176.396
Bulgaria		38.336,0				38.336
Canada	582.351,0	36.569,0	6.995,0	217.989,0	2.349,0	846.253
Chile*		26.730,0				26.730
China		13.806.331,7	131.193.668,3			145.000.000
Cyprus		854.637,0	3.883,1			858.520
Czech Republic	14.620,8	148.646,4	33.030,4			196.298
Denmark	20.515,2	459.865,6	7.684,0	3.264,0	18.000,0	509.329
Estonia		1.951,2	390,0			2.341
Finland	11.779,2	26.118,4	2.342,4			40.240
France incl. DOM*	92.897,3	1.825.836,0	54.900,0			1.973.633
Germany*	663.552,0	10.726.731,0	1.206.422,8		33.600,0	12.630.306
Greece		4.062.200,0	14.800,0			4.077.000
Hungary	5.688,0	105.011,0	23.803,0	500,0	200,0	135.202
India		2.838.948,0	242.247,0		16.320,0	3.097.515
Ireland		85.475,2	35.492,5			120.968
Israel*	29.900,0	4.087.895,0		450,0		4.118.245
Italy	43.765,5	1.804.597,0	252.981,5			2.101.344
Japan		5.622.949,0	97.297,0		472.376,0	6.192.622
Jordan		689.371,2	205.916,1			895.287
Korea, South		1.496.513,9				1.496.514
Latvia		6.904,0	140,0			7.044
Lebanon**		348.312,0				348.312
Lithuania		4.168,4	150,0			4.318
Luxembourg		24.482,0	1.818,0			26.300
Macedonia		25.020,1	723,8		4,0	25.748
Malta		33.144,0	11.723,0			44.867
Mexico	572.091,9	619.432,5	70.430,0		5.403,0	1.267.357
Morocco**		272.000,0				272.000
Namibia		15.258,7	447,2			15.706
Netherlands	377.287,0	378.051,0				755.338
New Zealand	7.025,4	142.975,3	9.644,4			159.645
Norway	1.920,0	13.010,0	540,0		1.110,0	16.580
Poland		394.188,0	115.648,0			509.836
Portugal*	2.081,5	544.703,3	19.362,7			566.148
Romania		85.496,0	9.000,0			94.496
Slovakia		107.891,8	12.854,6			120.746
Slovenia		135.656,0	9.041,6			144.698
South Africa	753.678,2	288.709,8	20.972,0			1.063.360
Spain	111.000,0	1.885.000,0	116.000,0			2.112.000
idctlparSweden	125.000,0	241.000,0	49.000,0			415.000
Switzerland	211.790,0	621.780,0	38.290,0	859.000,0		1.730.860
Taiwan	1.937,0	1.856.659,3	64.167,7			1.922.764
Thailand		91.391,8				91.392
Tunisia		384.000,0	21.000,0			405.000
Turkey*		12.214.904,0				12.214.904
United Kingdom		364.138,2	95.445,0			459.583
United States	17.793.589,1	2.553.983,8	87.755,3		97.877,6	20.533.206
Uruguay		12.096,0				12.096
Zimbabwe		17.509,0	162,0			17.671
TOTAL	27.589.699	83.351.167	134.290.981	1.081.581	647.240	246.960.668

* revised due to new / adapted database in 2012

** new 2012

Table 17: Total collector area in operation by the end of 2009 [m²]

7.6 References to reports and persons that have supplied the data

The production of the solar heat worldwide report edition 2012 was kindly supported by national representatives of the recorded countries or other official sources of information as cited below.

COUNTRY	CONTACT	SOURCE REMARKS
Albania	**Edmond M. Hido**	Albania-EU Energy Efficiency Centre (EEC)
Australia	**Sonja Ott**	Renewable Energy Team- Sustainability Victoria new installed capacity in 2010 from Sonja Ott; totals projected by AEE INTEC
Austria	**Werner Weiss; Manuela Eberl**	AEE INTEC
Belgium		ESTIF 2011 new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Brazil	**Marcelo Mesquita; Ronaldo Yano Toraiwa**	Gestor do DASOL - Depto. Nac. Aquecimento Solar da ABRAVA Data of 2011 version of this report revised according to database of DASOL/ ABRAVA;
Bulgaria	**ESTIF 2011 (estimation)**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Canada	**Doug McClenahan; Reda Djebbar**	Natural Resources Canada; SAIC Canada SAIC Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2010); Reda Djebbar, Doug McClenahan
Chile	**CDT Chile**	http://www.cdt.cl/cdt/uploads/anuario_solar_2011.pdf Data of 2011 version of this report revised accordingly
China	**Hu Runqing**	Center for Renewable Energy Development - Energy Research Institute (NDRC)
Cyprus	**Soteris Kalogirou, PhD, DSc**	Cyprus University of Technology
Czech Republic	**Tomas Matuska**	Ministry of Industry and Trade; Bufka, A.: Solar collectors in 2010 - statistical review new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Denmark	**Jan Erik Nielsen**	Danish Solar Heating Association / ESTIF 2011 new installed according to Danish Solar Heating Association; total installed projected from AEE INTEC database
Estonia	**ESTIF 2011 (estimation)**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Finland	**ESTIF 2011 (estimation)**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
France incl. DOM	**Céline Coulaud / ESTIF 2011**	ADEME - Centre de Sophia Antipolis / ESTIF 2011 Unglazed water collectors from historic AEE INTEC recordings; France overseas dept. according to ESTIF estimations

Germany	**Jan Knaack; Harald Drück**	Bundesverband Solarwirtschaft e.V.; Unglazed water collectors from historic AEE INTEC recordings (less out of operation collectors since 2007)
Greece	**Costas Travasaros; Vassiliki Drosou**	Centre for Renewable Energy Sources (CRES) / ESTIF 2011
Hungary	**Pál Varga**	Hungarian Solar Thermal Industry Federation (MÉGNAP) personal estimation Pál Varga
India	**Ministry Of New and Renewable Energy**	http://mnre.gov.in/achievements.htm
Ireland	**Emer Dennehy**	Energy policy statistical support unit of Sustainable Energy Authority of Ireland Grant scheme data; GHS and REHEAT programmes; BER database
Israel	**Eli Shilton**	solar energy systems ltd Data for 2009 revised according to data from the Interdisciplinary Center for Technological Analysis and Forecasting (ICTAF); Asher Vaturi
Italy	**Valeria Verga / ESTIF2011**	Associazione Italiana Solare Termico (Assolterm) / ESTIF 2011 Assolterm-Assotermica market study; Share between types of collectors according to ESTIF 2011
Japan	**Yamashita Noriaki**	Institute for Sustainable Energy Policies (ISEP); Solar System Development Association (SSDA) http://www.ssda.or.jp/profile/img/b11.pdf
Jordan	**Nidal Abdalla**	National Energy Research Center (NERC), Department of Statistic Survey
Korea, South		Korea New and Renewable Energy Center (KNREC) new installed according to Korea New and Renewable Energy Center (KNREC); total installed projected from AEE INTEC database
Latvia	**ESTIF 2010 (estimation)**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Lebanon	**Adel Mourtada**	Lebanese Association for Energy Saving & for Environment (ALMEE) Mourtada, A.: Market analysis of Solar Thermal Systems in Lebanon; proceedings ESTEC 2011; Marseille, France
Lithuania	**ESTIF 2010**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Luxembourg	**ESTIF 2010**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Malta	**Godwin Sant**	Malta Resources Authority
Mexico	**Vicente Estrada-Cajigal**	Asociación Nacional de Energía Solar (ANES) http://www.anes.org/anes/index.php?option=com_wrapper&Itemid=13
Morocco	**Said Mouline**	National Agency for the Development of Renewable Energy and Energy Efficiency (ADEREE) http://www.solarthermalworld.org/node/2849
Namibia	**Kudakwashe Ndhlukula**	Renewable Energy & Energy Efficiency Institute (REEEI) REEEI Annual Market Survey

Netherlands	**Reinoud Segers**	Statistics Netherlands (CBS)
Norway	**Peter Bernhard**	KanEnergi AS
Poland	**Grzegorz Wiśniewski; Aneta Wiecka**	EC BREC Institute for Renewable Energy Ltd.
Portugal	**João Farinha Mendes**	Associação Portuguesa da Indústria Solar (APISOLAR)
Romania	**ESTIF 2009 (estimation)**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Slovakia	**ESTIF 2009**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
Slovenia	**ESTIF 2009**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
South Africa	**Dieter Holm**	SOLTRAIN Southern Africa / The South African Solar Water Heater Industry New unglazed water collectors installed in 2010 estimated by AEE INTEC
Spain	**Pascual Polo**	Asociación Solar de la Industria Térmica (ASIT)
Sweden	**Jan-Olof Dalenbäck**	Svensk solenergi; CHALMERS University of Technology
Switzerland	**Urs Wolfer**	SWISSOLAR Markterhebung Sonnenergie, 2009
Taiwan	**K.M. Chung**	Energy Research Center - National Cheng Kung University
Tunisia	**Moncef Njaimi**	National Agency of Energy Conservation (ANME)
Turkey	**A. Kutay Ulke**	EZINC Metal San. Tic. A.S. New and total installed capacity revised according to new database
United Kingdom	**ESTIF 2011**	new installed according to ESTIF 2011; total installed projected from AEE INTEC database
United States	**Solar Energie Industries Association (SEIA)**	http://www.seia.org/galleries/pdf/SMI-YIR-2010-ES.pdf Historical data from U.S. Department of Energy (DoE) - Energy Information Administration (EIA)
Zimbabwe	**Anton Schwarzlmüller**	DSH, Soltrain

7.6.1 Additional literature and web sources used

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- http://www.solrico.com/
- http://www.solarthermalworld.org/
- http://www.tech4cdm.com/

7.7 List of Figures

7.8 List of Tables