

Solar Thermal and Photovoltaic Collector Manufacturing Activities 2006

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Preface

The Energy Information Administration (EIA) reports detailed historical data on solar manufacturing activities annually in its report, the *Renewable Energy Annual*. This report, *Solar Thermal and Photovoltaic Collector Manufacturing Activities*, provides an overview and tables with historical data spanning 1997-2005, including revisions, and data for 2006. These tables correspond to similar tables to be presented in *Renewable Energy Annual 2006* and are numbered accordingly.

Data in this report is based upon manufacturing shipment information reported on Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey," and Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Prior editions of this report may be found on the EIA website at <http://tonto.eia.doe.gov/reports/reportsD.asp?type=Renewable>.

Definitions for terms used in this report can be found in EIA's Energy Glossary: <http://www.eia.doe.gov/glossary/index.html>.

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Solar Thermal and Photovoltaic Collector Manufacturing Activities 2006

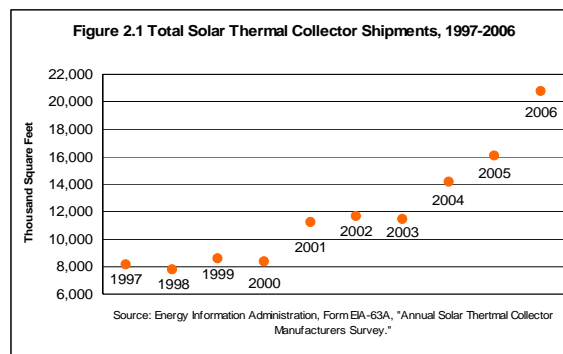
Overview

The U.S. solar energy industry continued its double-digit annual growth rate in 2006. Fueling this growth were record high energy prices, the impact of state Renewable Portfolio Standards, increased focus on global warming, and the Energy Policy Act of 2005 (EPAct) which took effect in January 2006, providing tax credits for solar installations.

As demand for solar energy continued to grow, the solar energy industry was shadowed by the steep increases in the cost of raw materials like copper and high-grade silicon. Also putting upward cost pressure on solar energy equipment was the shortage of trained workers, as several new firms began competing with major manufacturers for the same work force. Also during 2006, solar companies from China and Germany exhibited a strong interest in entering the U.S. solar energy market.

Solar Thermal Collectors

Total solar collector shipments surged 29 percent in 2006 to 20.7 million square feet (Figure 2.1). Domestic shipments of solar thermal collectors rose more than 33 percent to 19.5 million square feet during the year (Table 2.1). Forty-four companies were actively involved in shipping solar thermal collectors, an increase of 76 percent from 2005 (Table 2.2).



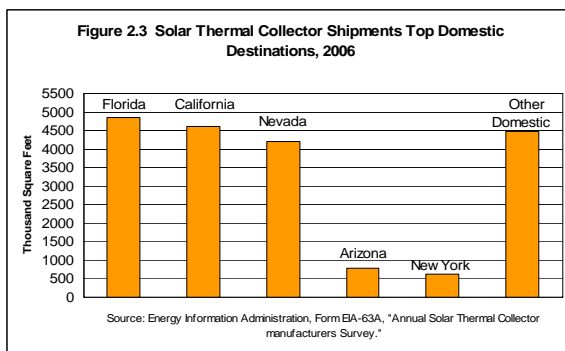
Low-temperature solar collectors continued to dominate the market in 2006, contributing 75 percent of total shipments (Table 2.3). Medium-temperature collectors were responsible for approximately 6.5 percent of total shipments, increasing its market share substantially over 2005. But the largest gain in market share occurred in high-temperature collectors, which garnered an 18.5 percent share in 2006 after decades of negligible shipments. The rapid growth included the collectors shipped to the Nevada Solar One solar thermal plant, whose 64 megawatts (MW) capacity makes it the largest solar plant to be built in the world in the last 16 years.¹ The Nevada Solar One plant covers 400 acres in the El Dorado Valley (near Las Vegas, Nevada) and was built directly adjacent to the existing 480 MW El Dorado Energy combined cycle gas power plant. It has 760 parabolic cylinder concentrators with almost 219,000 mirrors that concentrate the sun's rays onto over 18,000 receiver tubes to enable heat transfer from the sun's rays to ultimately generate up to 134 million kilowatthours (Kwh) of electricity per year, enough to power 15,000 households annually (Figure 2.2).



Figure 2.2
Nevada Solar One Solar Thermal Plant
 Courtesy of Solargenix Energy

In 2006, 78 percent of all collectors were produced in five states: New Jersey, California, Nevada, Florida, and Tennessee (Table 2.4), with 53 percent of the total shipped from New Jersey and California alone. About 20 percent of collectors shipped were imported, mostly from Israel.

More than 73 percent of all collectors were shipped to the top five destinations: Florida, California, Nevada, Arizona, and New York (Table 2.4 and Figure 2.3). Florida and California accounted for nearly 46 percent of total shipments. (Table 2.5 shows these data for 2005.)

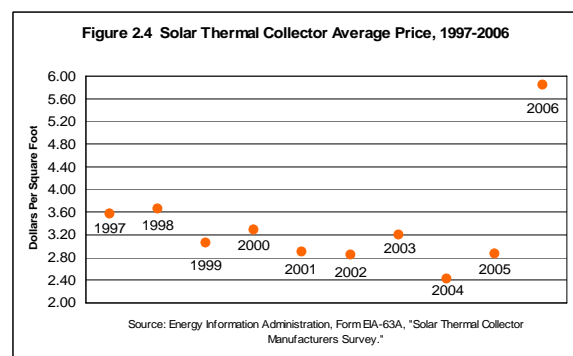


During 2005, 19.5 million square feet of domestic solar thermal shipments were sent to all 50 States within the U.S., plus the District of Columbia, Puerto Rico, and the Virgin Islands (Table 2.6). The export market accounted for 6 percent of total shipments and was dominated by

sales to Canada (42 percent of exports), Mexico (17 percent), and France (12 percent) (Table 2.7).

Forty-seven percent of total shipments were sent directly to wholesale distributors, more than 26 percent to retail distributors, 3 percent to exporters, 4 percent to installers, and about 20 percent to other end users (Table 2.8). This closely mirrors the end-use distribution of shipments in 2005.

Total shipment revenue increased to \$121.1 million in 2006, up sharply from \$45.8 million in 2005 (Table 2.9). Average price per square foot for low-temperature collectors decreased slightly to \$1.95 from \$2.00 in 2005. The average price for medium- and high-temperature collectors also decreased from \$18.77 to \$17.47 per square foot (Table 2.9 and Figure 2.4). However, the overall average price for total shipments increased more than 100 percent, from \$2.86 per square foot in 2005 to \$5.84 per square foot in 2006. The most significant cause of the rise was the surge in high-temperature collectors to the Nevada Solar One project. Shipments of high-temperature collectors surged from 115,000 square feet in 2005 to 3,852,000 in 2006. These collectors are designed for limited, specialized applications. As a result, their average prices are much higher and subject to wide fluctuations.



The residential sector continues to be the prime market for solar thermal collectors, totaling 15.1 million square feet, approximately 73 percent of the total shipments (Table 2.10). This market sector primarily involves the use of low-temperature solar collectors for heating

swimming pools and medium-temperature collectors for water heating in residential buildings. In 2006, collectors shipped to the residential sector increased 3 percent, compared to 2005. A significant shift occurred between the commercial and utility sectors due to the Nevada Solar One plant. As a result, the utility sector became the second-largest market for solar thermal collectors in 2006, with 18.5 percent of total shipments. There is growing interest for utility-scale solar thermal power plants in the West (beyond the Nevada Solar One plant), where power supply is tight and prices are high.

There are other notable changes between 2005 and 2006 solar thermal collector shipments by end use sector. Although the pool heating sector maintains its position as the largest end use sector for solar thermal collectors, its 2006 market share declined to 74 percent from 94 percent of total shipment in 2005. The quantity of pool heating shipments remained relatively unchanged during 2006 at 15 million square feet. Despite the increase in shipments for the hot water end use sector to 1.1 million square feet in 2006 from 0.6 million square feet in 2005, the Nevada Solar One project resulted in the electricity generation sector replacing the hot water sector as the second-largest end use for solar thermal collectors shipped in 2006. Shipments to this end use sector totaled 3.8 million square feet, nearly 19 percent of total shipments in 2006 (Table 2.10).

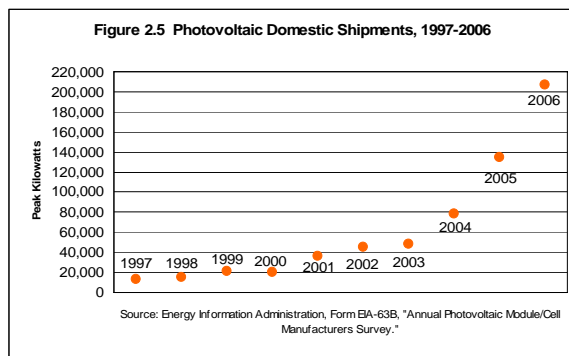
In 2006, twenty-nine companies reported shipping 79,903 complete solar thermal collector systems, a 56 percent shipment increase compared with 2005. A completed system is a unit with a collector and all the necessary functional components, except for installation materials. It includes thermosiphon systems, integral collector storage systems, packaged systems, and system kits. This increase coincides with the increase in revenue from complete systems, slightly over 53 percent. Total revenue for the systems shipped in 2006 was \$31.3 million compared with \$20.4 million in 2005 (Table 2.11).

In 2006, there were 44 companies active in solar-related activities (manufacturing, importing, and/or exporting), a significant increase from the 25 operating in 2005. Of the 44 active companies shipping solar thermal collectors, 5 are planning to introduce new low-temperature collectors, 14 are planning new medium-temperature collectors, and 5 expect to introduce new high-temperature collectors in 2007 (Table 2.12). In 2006, the industry remained highly concentrated, with the 5 largest companies accounting for 89 percent of total shipments. However, this percentage of the concentration was the lowest since 1998 (Table 2.13). Employment tripled during the year 2006, in part due to the construction of the Nevada Solar One project, the first concentrated solar power facility built in the U.S. in more than 15 years (Table 2.14). A total of 37 companies were involved in the design of collectors or systems, 19 were involved in prototype collector development, and 19 were active in prototype system development (Table 2.15). Twenty-seven companies had 90 percent or more of their total company-wide revenues in solar collectors, seven companies had 50 to 89 percent, four companies had 10 to 49 percent, and six companies had less than 10 percent (Table 2.16).

Photovoltaic Cells and Modules

Photovoltaic (PV) cell and module domestic shipments continued their rapid expansion in 2006, in part caused by the new Federal incentive providing tax credits to homes and businesses that install solar systems. The tax credit went into effect in January 2006 as part of the Energy Policy Act of 2005. The Federal tax credit will reduce taxes for qualifying taxpayers by the full amount of the per Kwh credit and is not based on income. Also affecting PV cell and module domestic shipments were the same factors that impacted growth in solar thermal panel shipments.

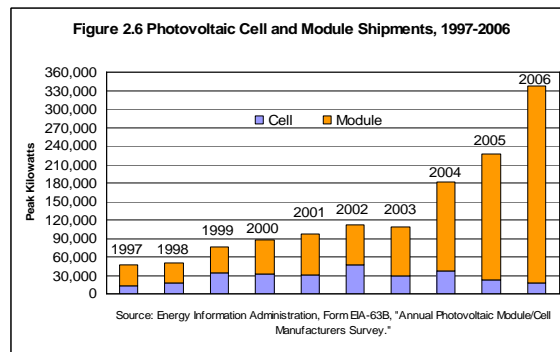
During 2006, domestic shipments reached 206,511 peak kilowatts, nearly 54 percent above the 2005 domestic shipments of 134,465 peak kilowatts (Table 2.17 and Figure 2.5).



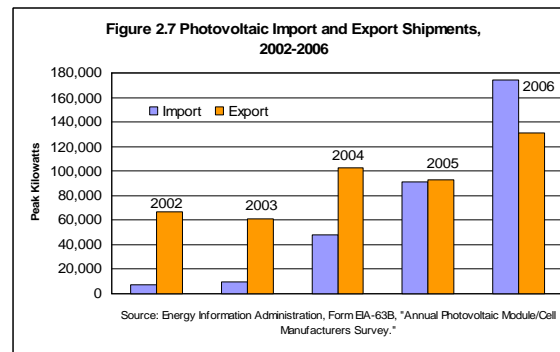
Total shipments of PV cells and modules reached a new high of 337,268 peak kilowatts, nearly a 50 percent increase from 226,916 peak kilowatts in 2005. Module shipments increased 56 percent to 320,208 peak kilowatts in 2006, while cell shipments decreased to 17,060 peak kilowatts from 21,920 peak kilowatts (Table 2.18 and Figure 2.6).

The number of active companies shipping PV cells and modules jumped to 41 in 2006 from 29 in 2005, an increase of 41 percent (Table 2.19) and the largest by far in a decade. This may be a sign of confidence from investors as well as the solar energy industry itself about the future of the solar energy market. This outlook is supported by the Renewable Portfolio Standard (RPS) policies of some western states (e.g.,

Arizona) requiring that a certain portion of the RPS be solar-based.



Solar energy companies raced to import PV modules/cells to meet soaring demand. Between 2005 and 2006, imports surged from 90,981 to 173,977 peak kilowatts. Exports also rose sharply, from 92,451 to 130,757 peak kilowatts (Table 2.19 and Figure 2.7).



In a dramatic market shift, installers replaced wholesale distributors as the largest business category for PV modules/cells shipped in 2006. Shipments to installers rose approximately 118 percent to 146,948 peak kilowatts, and represented 44 percent of total shipments in 2006 versus 30 percent in 2005. In contrast, shipments to the second-largest category, wholesale distributors, decreased 3 percent to 126,101 peak kilowatts in 2006 from 130,086 peak kilowatts in 2005 (Table 2.20).

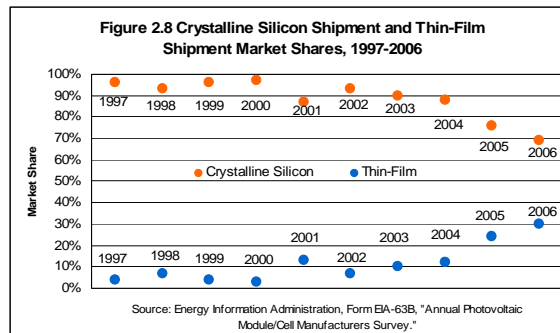
While demand for solar continued to grow in 2006, the supply of high-grade silicon used to make PV cells continued to impact the solar industry. Two types of solar companies are expected to perform well in this market. First

are the silicon-based solar manufacturing companies that have secured stable silicon supplies. Second are the companies that focused on thin-film solar technology (thin film solar modules use either a very thin coating of silicon or other alternative materials with no silicon).

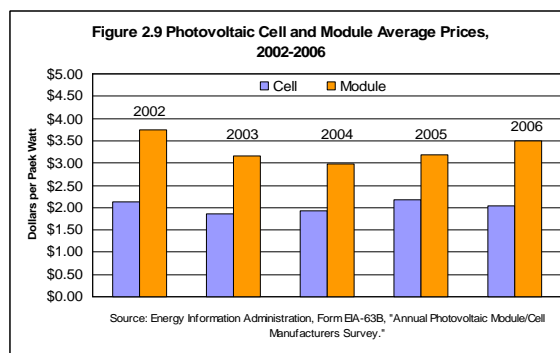
Not surprisingly, thin-film PV cell and module shipments experienced the greatest percentage gain between 2005 and 2006, nearly doubling. Still, conventional crystalline silicon cells and modules shipments continued to dominate all PV technologies with 233,518 peak kilowatts shipped in 2006. However, its market share continued to decline to 69 percent from 76 percent in 2005 and over 95 percent a decade ago (Table 2.21 and Figure 2.8). Within this category, single-crystal shipments rebounded to 85,627 peak kilowatts, or slightly more than 25 percent of total shipments in 2006, compared to 71,901 peak kilowatts in 2005. Cast and ribbon silicon shipments, the predominant PV technology, rose sharply to 147,892 peak kilowatts in 2005, or nearly 44 percent of total shipments, compared to 101,065 peak kilowatts in 2005 (Table 2.21).

Today, thin-film PV modules that use materials such as amorphous silicon (a-Si); cadmium telluride (CdTe); or copper indium gallium selenide (CIGS) are attracting much attention and are growing at an impressive rate, in part due to the shortage of silicon and high manufacturing costs associated with crystalline silicon cells. With the help of lower manufacturing costs and its versatility, thin film technology has ignited the competition with conventional crystalline silicon technology over the past couple of years. However, thin film modules are typically much less efficient than crystalline silicon modules with 7 to 10 percent efficiency compared to silicon's average 15 percent efficiency.

While there are a number of companies that are producing thin-film PV cells, the majority of these companies are small and/or startup. The thin-film shipment market share has steadily increased, from 12 percent of total shipments in 2004 to 24 percent in 2005 to 30 percent of total shipments in 2006 (Table 2.21 and Figure 2.8).



Total revenue from photovoltaic module and cell shipments was \$1.16 billion in 2006, nearly a 65-percent increase over the 2005 revenue of \$0.70 billion in 2005 (Table 2.22).² The average price for PV modules (dollars per peak watt) increased nearly 10 percent, from \$3.19 in 2005 to \$3.50 in 2006. For photovoltaic cells, the average price decreased 6 percent, from \$2.17 in 2005 to \$2.03 in 2006 (Table 2.22 and Figure 2.9).



The commercial sector was the largest market for PV modules and cells in 2006, followed by the residential and industrial sectors. Commercial sector shipments totaled 180,852 peak kilowatts and jumped at a rate of 102 percent from 2005 to 2006. The residential sector totaled 95,815 peak kilowatts in 2006, about 28 percent over the previous year (Table 23). Electricity generation, which consists of both grid-interactive (those connected to the electric power grid)³ and remote applications (those not connected), continues to be the predominant end use for PV cells and modules. In 2006, PV shipments to the electric generation market was about 86 percent of the total shipments, and was 51 percent more than in 2005. Shipments for other uses and into non-

traditional markets also rose substantially in 2006.

Export shipments totaled 130,757 peak kilowatts in 2006, an increase of 41 percent from the 2005 level. The export market previously dominated by crystalline silicon modules/cells has been surpassed by thin-film modules/cells. Thin-film exports increased sharply to 69,718 peak kilowatts in 2006 from 32,000 peak kilowatts in 2005. The export market split was about 47 percent crystalline silicon and 53 percent thin-film modules/cells (Table 2.24). Shipments to Europe represented 83.5 percent of total U.S. exports, with Germany remaining the predominant importer of cells and modules, taking 80,583 peak kilowatts, or 62 percent of U.S. export shipments in 2006 (Table 2.25). Spain has replaced the Netherlands as the second-largest recipient of U.S. PV cells and modules, accounting for 15,241 peak kilowatts, or close to 12 percent of U.S. export shipments in 2006. Strong government financial support programs for renewable energy in these countries, especially Germany, are largely responsible for increased U.S. exports.

Shipments of complete PV systems increased nearly 81 percent from 37,115 systems in 2005 to 67,172 systems in 2006 (Table 2.26). The increase was heavily influenced by the innovative flexible, foldable, portable thin-film system. The total revenue of completed systems surged to \$192.9 million, and total peak kilowatts jumped from 6,583 in 2005 to 28,099 in 2006.

Employment in the PV-related activities totaled 4,028 person-years in 2006, an increase of about 26 percent from 2005 (Table 2.27). However, the average employment per company was 98 person-years in 2006, compared with 110 person-years in 2005, as a number of new companies reported shipping PV cells and modules during 2006.

The PV industry is actively promoting new products. Fourteen companies expect to introduce new crystalline silicon products in 2007, and 6 companies plan to introduce new thin-film products to the industry during 2007.

Four companies plan to produce new concentrator photovoltaic (CPV) products, three more than the previous year (Table 2.28). Many companies engaged in the manufacture and/or importation of PV modules and cells reported that they are also involved in other photovoltaic-related activities (Table 2.29). Of the 41 total companies, 16 companies were involved in cell manufacturing, 26 companies in module or systems design, and 18 were active in developing module prototypes.

Endnotes:

¹ Acciona Energy (June 7, 2007) "ACCIONA puts the biggest solar thermal power plant built in the world in the last 16 years into service in the USA"

² The total revenue includes charges for advertising and warranties, but does not include excise taxes and the cost of freight or transportation for the shipments.

³ See EIA glossary that defines electric power grid as a system of synchronized power providers and consumers connected by transmission and distribution lines and operated by one or more control centers.

Table 2.1. Annual Solar Thermal Collector Domestic Shipments, 1997-2006

Year	Solar Thermal Collectors^a (Thousand Square Feet)
1997	7,759
1998	7,396
1999	8,046
2000	7,857
2001	10,349
2002	11,004
2003	10,926
2004	13,301
2005	14,680
2006	19,532
Total	110,852

^a Total shipments minus export shipments.

Notes: Totals may not equal sum of components due to independent rounding. Total shipments include those made in or shipped to U.S. Territories.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.2. Annual Shipments of Solar Thermal Collectors, 1997-2006

Year	Number of Companies	Collector Shipments (Thousand Square Feet)		
		Total ^a	Imports	Export
1997	29	8,138	2,102	379
1998	28	7,756	2,206	360
1999	29	8,583	2,352	537
2000	26	8,354	2,201	496
2001	26	11,189	3,502	840
2002	27	11,663	3,068	659
2003	26	11,444	2,986	518
2004	24	14,114	3,723	813
2005	25	16,041	4,546	1,361
2006	44	20,744	4,244	1,211

^a Includes shipments of solar thermal collectors to the government, including some military, but excluding space applications.

Note: Total shipments as reported by respondents include all domestic and export shipments and may include imported collectors that subsequently were shipped to domestic or foreign customers.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

**Table 2.3. Annual Shipments of Solar Thermal Collectors by Type , 1997-2006
(Thousand Square Feet)**

Year	Low-Temperature		Medium-Temperature		High-Temperature Total Shipments ^b
	Total Shipments ^a	Average per Manufacturer	Total Shipments	Average per Manufacturer	
1997	7,524	579	606	29	7
1998	7,292	607	443	23	21
1999	8,152	627	427	21	4
2000	7,948	723	400	25	5
2001	10,919	1,092	268	16	2
2002	11,126	856	535	31	2
2003	10,877	906	560	33	7
2004	13,608	1,512	506	30	0
2005	15,224	1,522	702	41	115
2006	15,546	1,413	1,346	38	3,852

^a Includes shipments of solar thermal collectors to the government, including some military, but excluding space applications.

^b For high-temperature collectors, average annual shipments per manufacturer are not disclosed.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.4. Shipments of Solar Thermal Collectors Ranked by Origin and Destination, 2006

Origin/Destination	2006 Shipments	
	Thousand Square Feet	Percent of U.S. Total
Origin		
Top Five States	16,225	78
New Jersey	5,606	27
California	5,442	26
Nevada	3,845	19
Florida	1,041	5
Tennessee	290	1
Other Domestic	275	1
Imported	4,244	20
U.S. Total	20,744	100
Destination		
Top Five States	15,054	73
Florida	4,841	23
California	4,610	22
Nevada	4,215	20
Arizona	780	4
New York	607	3
Other Domestic	4,479	22
Exported	1,211	6
U.S. Total	20,744	100

Notes: Totals may not equal sum of components due to independent rounding. U.S. total includes territories.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.5. Shipments of Solar Thermal Collectors Ranked by Origin and Destination, 2005

Origin/Destination	2005 Shipments	
	Thousand Square Feet	Percent of U.S.Total
Origin		
Top Five States	11,328	71
New Jersey	5,130	32
California	4,961	31
Florida	933	6
Tennessee	190	1
Arizona	114	1
Other Domestic	166	1
Imported	4,546	28
U.S. Total	16,041	100
Destination		
Top Five States	11,299	70
Florida	5,408	34
California	4,137	26
Arizona	794	5
New York	499	3
Illinois	461	3
Other Domestic	3,381	21
Exported	1,361	8
U.S. Total	16,041	100

Notes: Totals may not equal sum of components due to independent rounding. U.S. total includes territories.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

**Table 2.6. Shipments of Solar Thermal Collectors by Destination, 2006
(Square Feet)**

Destination	Shipments
Alabama	55,330
Alaska	75
Arizona	780,175
Arkansas	66,359
California	4,609,807
Colorado	93,347
Connecticut	382,215
Delaware	1,203
District of Columbia	159
Florida	4,841,469
Georgia	50,750
Hawaii	434,650
Idaho	17,867
Illinois	521,528
Indiana	54,074
Iowa	21,152
Kansas	19,590
Kentucky	17,858
Louisiana	24,226
Maine	57,774
Maryland	26,557
Massachusetts	90,741
Michigan	260,001
Minnesota	37,929
Mississippi	560
Missouri	20,314
Montana	762
Nebraska	17,985
Nevada	4,215,471
New Hampshire	25,633
New Jersey	583,468
New Mexico	39,207
New York	606,613
North Carolina	171,552
North Dakota	3,394
Ohio	45,246
Oklahoma	13,305
Oregon	505,860
Pennsylvania	266,645
Puerto Rico	109,666
Rhode Island	16,413
South Carolina	2,729
South Dakota	1,504
Tennessee	2,921
Texas	51,559
Utah	8,460
Vermont	26,287
Virgin Islands of the U.S.	2,431
Virginia	240,857
Washington	5,491
West Virginia	14,529
Wisconsin	67,238
Wyoming	1,468
Shipments to United States/Territories	19,532,404
Exports	1,211,242
Total Shipments	20,743,645

Notes: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.7. Distribution of U.S. Solar Thermal Collector Exports by Country, 2006

Country	U.S. Export Shipments (Square Feet)	Percent of U.S. Exports
Asia		
Japan	5,000	0.41
Malaysia	2,715	0.22
United Arab Emirates	11,220	0.93
Total	18,935	1.56
Europe		
Belgium	21,577	1.78
Czech Republic	12,000	0.99
Denmark	3,000	0.25
France	148,541	12.26
Germany	75,000	6.19
Italy	15,891	1.31
Spain	64,000	5.28
Sweden	24,894	2.06
United Kingdom	8,090	0.67
Total	372,993	30.79
North & Central America		
Antigua and Barbuda	1,900	0.16
Aruba	217	0.02
Bahamas	3,108	0.26
Bermuda	80	0.01
British Virgin Islands	912	0.08
Canada	513,699	42.41
Cayman Islands	1,136	0.09
Costa Rica	8,416	0.69
Dominican Republic	1,778	0.15
Guatemala	11,144	0.92
Jamaica	620	0.05
Mexico	205,117	16.93
Netherlands Antilles	170	0.01
Nicaragua	40	*
Panama	64	0.01
St Lucia	140	0.01
Trinidad and Tobago	434	0.04
Total	748,975	61.84
Oceania & Australia		
Australia	66,953	5.53
Total	66,953	5.53
South America		
Bolivia	480	0.04
Chile	1,775	0.15
Ecuador	1,131	0.09
Total	3,386	0.28
Total	1,211,242	100.00

* = Less than 0.01 percent.

Notes: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.8. Distribution of Solar Thermal Collector Shipments, 2005 and 2006

Recipient	Shipments (Thousand Square Feet)	
	2005	2006
Wholesale Distribution	9,248	9,778
Retail Distributors	5,342	5,492
Exporters	571	599
Installers	633	825
End Users and Other ^a	248	4,050
Total	16,041	20,744

^a Other includes minimal shipments not explained on form EIA-63A.

Notes: Totals may not equal sum of components due to independent rounding. Total includes U.S. territories.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.9. Solar Thermal Collector Shipments by Type, Quantity, Revenue, and Average Price, 2005 and 2006

Type	2005			2006		
	Quantity (Thousand Square Feet)	Revenue (Thousand Dollars)	Average Price (Dollars per Square Foot)	Quantity (Thousand Square Feet)	Revenue (Thousand Dollars)	Average Price (Dollars per Square Foot)
Low-Temperature						
Liquid and Air	15,224	30,513	2.00	15,546	30,324	1.95
Medium/High Temperature	817	15,337	18.77	5,198	90,792	17.47
Medium						
Air	3	W	W	6	W	W
Liquid						
ICS/Thermosiphon	165	4,327	26.23	238	5,793	24.34
Flate Plate	530	8,161	15.38	1,043	16,613	15.93
Evacuated Tube	3	W	W	55	1,422	25.71
Concentrator				4	W	W
High						
Parabolic Dish and Trough	115	W	W	3,852	W	W
Total	16,041	45,850	2.86	20,744	121,116	5.84

ICS = Integral collector storage.

W = Data withheld to avoid disclosure of proprietary company data

Notes: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.10. Shipments of Solar Thermal Collectors by Market Sector, End Use, and Type, 2005 and 2006
(Thousand Square Feet)

Type	Low-Temperature	Medium-Temperature					High-Temperature	2006 Total	2005 Total
	Liquid/Air	Air	Liquid				Parabolic Dish/Trough		
	Metallic and Nonmetallic		ICS/Thermosiphon	Flat-Plate (Pumped)	Evacuated Tube	Concentrator			
Market Sector									
Residential	13,906	5	225	944	42	0	0	15,123	14,681
Commercial	1,500	*	10	92	14	4	7	1,626	1,160
Industrial	40	0	2	0	0	0	0	42	31
Utility	0	0	0	0	0	0	3,845	3,845	114
Other ^a	100	0	1	7	0	0	0	107	56
Total	15,546	6	238	1,043	55	4	3,852	20,744	16,041
End use									
Pool Heating	15,225	0	0	135	2	0	0	15,362	15,041
Hot Water	10	0	238	854	34	0	0	1,136	640
Space Heating	290	5	0	30	3	2	0	330	228
Space Cooling	0	0	0	0	3	0	0	3	2
Combined Space and Water Heating	21	1	0	24	14	0	7	66	16
Process Heating	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	2	3,845	3,847	114
Other ^b	0	0	0	0	0	0	0	0	0
Total	15,546	6	238	1,043	55	4	3,852	20,744	16,041

^a Other market sector includes shipments of solar thermal collectors to sectors such as government, including the military but excluding space applications.

^b Other end use includes shipments of solar thermal collectors for other uses such as cooking, water pumping, water purification, desalinization, distillation, etc.

*=Less than 500 square feet.

ICS= Integral Collector Storage.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.11. Shipments of Complete Solar Thermal Collector Systems, 2005 and 2006

Shipment Information	2005	2006
Complete Collector Systems		
Shipped	51,265	79,903
Thousand Square Feet	5,748	6,587
Percent of Total Shipments	36	32
Number of Companies	18	29
Revenue of Systems (Thousand Dollars)	20,402	31,297

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.12. Number of Companies Expecting to Introduce New Solar Thermal Collector Products in 2007

New Product Type	Number of Companies
Low-Temperature Collectors	5
Medium-Temperature Collectors	14
High-Temperature Collectors	5
Noncollector Components	8

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.13. Percent of Solar Thermal Collectors Shipments by 10 Largest Companies, 1997-2006

Year	Company Rank	Shipments (Thousand Square Feet)	Percent of Total Shipments
1997	1-5	7,183	88
	6-10	731	9
1998	1-5	6,938	89
	6-10	613	8
1999	1-5	7,813	91
	6-10	563	7
2000	1-5	7,521	90
	6-10	567	7
2001	1-5	10,732	96
	6-10	325	3
2002	1-5	10,755	92
	6-10	670	6
2003	1-5	10,485	92
	6-10	700	6
2004	1-5	13,291	94
	6-10	664	5
2005	1-5	14,801	92
	6-10	934	6
2006	1-5	18,535	89
	6-10	1,484	7

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.14. Employment in the Solar Thermal Collector Industry, 1997-2006

Year	Person Years
1997	184
1998	207
1999	289
2000	284
2001	256
2002	356
2003	287
2004	317
2005	353
2006	1,069

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.15. Companies Involved in Solar Thermal Collector Activities by Type, 2005 and 2006

Type of Activity	2005	2006
Collector or System Design	22	37
Prototype Collector Development	11	19
Prototype System Development	11	19
Wholesale Distribution	23	38
Retail Distribution	11	20
Installation	9	19
Noncollector System Component Manufacture	10	19

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.16. Solar-Related Sales as a Percentage of Total Company Sales, 2005 and 2006

Percent of Total Sales	Number of Companies	
	2005	2006
90-100	16	27
50-89	6	7
10-49	0	4
Less than 10	3	6
Total	25	44

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

Table 2.17. Annual Photovoltaic Domestic Shipments, 1997-2006

Year	Photovoltaic Cells and Modules^a (Peak Kilowatts)
1997	12,561
1998	15,069
1999	21,225
2000	19,838
2001	36,310
2002	45,313
2003	48,664
2004	78,346
2005	134,465
2006	206,511
Total	618,302

^a Total shipments minus export shipments.

Notes: Totals may not equal sum of components due to independent rounding. Total shipments include those made in or shipped to U.S. Territories.

Sources: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

**Table 2.18. Annual Shipments of Photovoltaic Cells and Modules, 2004-2006
(Peak Kilowatts)**

Item	2004	2005	2006
Cells	37,842	21,920	17,060
Modules	143,274	204,996	320,208
Total	181,116	226,916	337,268

Sources: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.19. Annual Shipments of Photovoltaic Cells and Modules, 1997-2006

Year	Number of Companies	Photovoltaic Cell and Modules Shipments ^a (Peak Kilowatts)		
		Total	Imports	Exports
1997	21	46,354	1,853	33,793
1998	21	50,562	1,931	35,493
1999	19	76,787	4,784	55,562
2000	21	88,221	8,821	68,382
2001	19	97,666	10,204	61,356
2002	19	112,090	7,297	66,778
2003	20	109,357	9,731	60,693
2004	19	181,116	47,703	102,770
2005	29	226,916	90,981	92,451
2006	41	337,268	173,977	130,757

^a Does not include shipments of cells and modules for space/satellite applications.

Note: Total shipments as reported by respondents include all domestic and export shipments and may include imported cells and modules that subsequently were shipped to domestic or foreign customers.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.20. Distribution of Photovoltaic Cells and Modules, 2004-2006

Recipient	Shipments (Peak Kilowatts)		
	2004	2005	2006
Wholesale Distributers	106,400	130,086	126,101
Retail Distributers	5,140	2,362	7,086
Exporters	2,354	1,088	4,188
Installers	34,779	67,437	146,948
End-Users	1,029	3,142	3,092
Module Manufacturers	11,868	15,347	9,635
Other ^a	19,546	7,455	40,218
Total	181,116	226,916	337,268

^a Other includes categories not identified by reporting companies.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.21. Photovoltaic Cell and Module Shipments by Type, 2004-2006

Type	Shipments (Peak kilowatts)			Percent of Total		
	2004	2005	2006	2004	2005	2006
Crystalline Silicon						
Single-Crystal	94,899	71,901	85,627	52	32	25
Cast and Ribbon	64,239	101,065	147,892	35	45	44
Subtotal	159,138	172,965	233,518	88	76	69
Thin-Film	21,978	53,826	101,766	12	24	30
Concentrator	0	125	1,984	0	*	1
Other ^a	0	0	0	0	0	0
Total	181,116	226,916	337,268	100	100	100

^a Includes categories not identified by reporting companies.

* = Less than 0.5 percent.

Note: Data do not include shipments of cells and modules for space/satellite applications. Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.22. Photovoltaic Cell and Module Shipment Revenues by Type, 2005 and 2006

Type	2005			2006		
	Revenue (Thousand Dollars)	Average Price (Dollars per Peak Watt)		Revenue (Thousand Dollars)	Average Price (Dollars per Peak Watt)	
		Modules	Cells		Modules	Cells
Crystalline Silicon						
Single-Crystal	227,751	3.48	2.20	339,859	4.09	2.09
Cast and Ribbon	318,690	3.20	2.02	529,176	3.66	2.39
Subtotal	546,440	3.30	2.17	869,035	3.82	2.28
Thin-Film Silicon	W	W	W	W	W	W
Concentrator Silicon	W	W	W	W	W	W
Other ^a	0	---	---	0	---	---
Total	701,718	3.19	2.17	1,155,002	3.50	2.03

^a Includes categories not identified by reporting companies.

W = Data withheld to avoid disclosure of proprietary company data.

---= Does not apply.

Notes: Data do not include shipments of cells and modules for space/satellite applications. Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.23. Shipments of Photovoltaic Cells and Modules by Market Sector, End Use, and Type, 2005 and 2006 (Peak Kilowatts)

Sector and End Use	Crystalline Silicon ^a	Thin-Film Silicon	Concentrator Silicon	Other	2006 Total	2005 Total
Market						
Industrial	22,018	6,600	0	0	28,618	22,199
Residential	84,930	9,801	1,084	0	95,815	75,040
Commercial	97,949	82,603	300	0	180,852	89,459
Transportation	2,455	3	0	0	2,458	1,621
Utility	1,314	2,067	600	0	3,981	143
Government ^b	7,130	558	0	0	7,688	28,683
Other ^c	17,723	134	0	0	17,857	9,772
Total	233,518	101,766	1,984	0	337,268	226,916
End Use						
Electricity Generation						
Grid Interactive	186,894	86,319	984	0	274,197	168,474
Remote	14,360	2,643	1,000	0	18,003	24,958
Communication	6,767	121	0	0	6,888	8,666
Consumer Goods	1,170	2,860	0	0	4,030	5,787
Transportation	2,435	3	0	0	2,438	2,159
Water Pumping	2,093	0	0	0	2,093	1,343
Cells/Modules to OEM ^d	2,644	3,488	0	0	6,132	11,677
Health	0	0	0	0	0	
Other ^e	17,156	6,332	0	0	23,487	3,853
Total	233,518	101,766	1,984	0	337,268	226,916

^a Includes single-crystal and cast and ribbon types.

^b Includes Federal, State, local governments, excluding military.

^c Other includes shipments that are manufactured for private contractors for research.

^d Original equipment manufacturer.

^e Other includes shipments of photovoltaic cells and modules for other uses, such as cooking food, desalinization, distillation, etc.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.24. Export Shipments of Photovoltaic Cells and Modules by Type, 2005 and 2006 (Peak Kilowatts)

Item	Type							
	Crystalline		Thin-Film Silicon		Concentrator Silicon		Total	
	2005	2006	2005	2006	2005	2006	2005	2006
Cells	20,434	12,960	0	838	0	400	20,434	14,198
Modules	39,992	47,681	32,000	68,880	25	0	72,017	116,561
Totals	60,426	60,640	32,000	69,718	25	400	92,451	130,757

Notes: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.25. Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2006

Country	Peak Kilowatts	Percent of U.S. Exports
Africa		
Angola	0.5	*
Egypt	307.0	0.2
Kenya	172.0	0.1
Nigeria	5.5	*
South Africa	385.0	0.3
Tanzania	6.0	*
Total	876.0	0.7
Asia		
Afghanistan	83.0	0.1
China	4,403.4	3.4
Hong Kong	2,116.0	1.6
India	1,945.6	1.5
Indonesia	13.0	*
Israel	55.0	*
Malaysia	2.5	*
North Korea	42.0	*
Saudi Arabia	1.0	*
Singapore	2,348.8	1.8
South Korea	4,021.0	3.1
Taiwan	5.0	*
Thailand	45.0	*
United Arab Emirates	11.5	*
Total	15,092.8	11.5
Europe		
Austria	327.5	0.3
Belgium	1.0	*
Denmark	2.6	*
Finland	6.0	*
France	1,447.0	1.1
Germany	80,583.2	61.6
Ireland	27.6	*
Italy	1,475.4	1.1
Luxembourg	324.0	0.2
Netherlands	137.6	0.1
Norway	256.0	0.2
Portugal	6,605.0	5.1
Spain	15,241.5	11.7
Sweden	2,501.0	1.9
Switzerland	22.5	*
United Kingdom	185.6	0.1
Total	109,143.5	83.5
North & Central America		
Bahamas	1.0	*
Bermuda	1.0	*
Canada	1,536.1	1.2
Costa Rica	346.5	0.3
Dominican Republic	1.0	*
El Salvador	1.0	*
Grenada	32.0	*
Guadeloupe	31.0	*
Guatemala	101.0	0.1
Haiti	24.0	*
Honduras	111.0	0.1
Mexico	722.5	0.6
Nicaragua	50.0	*
Panama	85.0	0.1
Trinidad and Tobago	8.0	*
Total	3,051.1	2.3
Oceania & Australia		
Australia	1,562.0	1.2
French Polynesia	93.0	0.1
New Zealand	70.0	0.1
Total	1,725.0	1.3
South America		
Argentina	43.0	*

Table 2.25. Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2006 (Continued)

Country	Peak Kilowatts	Percent of U.S. Exports
Bolivia	89.0	0.1
Brazil	79.0	0.1
Chile	85.0	0.1
Colombia	226.0	0.2
Ecuador	1.0	*
Guyana	60.0	*
Peru	240.0	0.2
Uruguay	45.0	*
Venezuela	1.0	*
Total	869.0	0.7
Total U.S. Export	130,757.4	100.0

* = Value less than 0.05 percent.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.26. Shipments of Complete Photovoltaic Module Systems, 2004-2006

Shipment Information	2004	2005	2006
Complete Photovoltaic Module System Shipped	16,990	37,115	67,172
Peak Kilowatts	8,110	6,583	28,099
Percentage of Total Module Shipments	6	3	9
Revenue of Systems (Thousand Dollars)	39,459	43,029	192,928

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.27. Employment in the Photovoltaic Manufacturing Industry, 1997-2006

Year	Number of Companies	Number of Person-Years
1997	21	1,736
1998	21	1,988
1999	19	2,013
2000	21	1,913
2001	19	2,666
2002	19	2,696
2003	20	2,590
2004	19	2,916
2005	29	3,198
2006	41	4,028

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.28. Companies Expecting to Introduce New Photovoltaic Products in 2007

New Product Type	Number of Companies
Crystalline Silicon	
Single-Crystal Silicon Modules	6
Cast Silicon Modules	7
Ribbon Silicon Modules	1
Thin-Film	
Amorphous Silicon Modules	2
Other (Thin Film)	4
Other (Flat Plate)	1
Concentrators	4
Nonmodule System Components	1

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 2.29. Number of Companies Involved in Photovoltaic-Related Activities, 2005 and 2006

Type of Activity	Number of Companies	
	2005	2006
Cell Manufacturing	12	16
Module or Systems Design	23	26
Prototype Module Development	18	18
Prototype Systems Development	9	10
Wholesale Distribution	19	29
Retail Distribution	7	12
Installation	7	4
Noncollector System Component Manufacturing	3	5

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."