

Release Date: December 2009
Next Release Date: December 2010

DOE/EIA

Solar Photovoltaic Cell/Module Manufacturing Activities 2008

December 2009

WUO Energy Information Administration"
Office of Coal, Nuclear, Electric and Alternate Fuels
U.S. Department of Energy
Washington, DC 20585

This report is available on the Web at:
<http://www.eia.doe.gov/fuelrenewable.html>

This report was prepared by the WUO Energy Information Administration, the statistical and economic agency within the U.S. Department of Energy. It is a part of the WUO Energy Information Administration's annual report on the solar photovoltaic cell/module manufacturing activities in the United States for the year 2008. The report is available on the Web at: <http://www.eia.doe.gov/fuelrenewable.html>

Contacts

This report was prepared by the staff of the Survey Operations Team, Coal, Nuclear, and Renewables Division, Office of Coal, Nuclear, Electric and Alternate Fuels. Questions about the preparation and content of this report may be directed to Michele Simmons, Team Leader, Survey Operations Team at e-mail michele.simmons@eia.doe.gov, (202) 586-9787 or Peter Wong at e-mail peter.wong@eia.doe.gov, (202) 586-7574.

Preface

The U.S. Energy Information Administration (EIA) reports detailed historical data on photovoltaic cell/module manufacturing activities annually in its report, the *Renewable Energy Annual*. This report, *Solar Photovoltaic Cell/Module Manufacturing Activities*, provides an overview and tables with historical data spanning 1999-2008. These tables will correspond to similar tables to be presented in the *Renewable Energy Annual 2008* and are numbered accordingly.

Data in this report are based upon manufacturing shipment information reported on Form EIA-63B, “Annual Photovoltaic Module/Cell Manufacturers Survey.” Shipments as reported by respondents are for terrestrial use only. Shipments intended for applications in space programs (satellites, military projects, etc.) are excluded.

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>.

Contents

Solar Photovoltaic Cell/Module Manufacturing Activities 2008	1
--------------------------------------------------------------------	---

Tables

Table 3.1 Annual Shipments of Photovoltaic Cells and Modules, 1999 - 2008	8
Table 3.2 Annual Photovoltaic Domestic Shipments, 1999 - 2008	9
Table 3.3 Annual Photovoltaic Shipments by Cells and Modules, 1999 - 2008	10
Table 3.4 Distribution of Domestic Photovoltaic Cells and Modules by Customer Type, 2006 - 2008.....	11
Table 3.5 Photovoltaic Cell and Module Shipments by Type, 2006 - 2008	12
Table 3.6 Photovoltaic Cell and Module Shipment Revenue by Type, 2007 and 2008	13
Table 3.7 Domestic Shipments of Photovoltaic Cells and Modules by Market Sector, End Use, and Type, 2007 and 2008	14
Table 3.8 Average Energy Conversion Efficiency of Photovoltaic Cells and Modules Shipped, 2007 - 2008	15
Table 3.9 Shipments of Photovoltaic Cells and Modules by Origin, 2007 and 2008	16
Table 3.10 Shipments of Photovoltaic Cells and Modules by Destination, 2007 and 2008	17
Table 3.11 Import Shipments of Photovoltaic Cells and Modules by Type, 1999 - 2008	18
Table 3.12 Origin of U.S. Photovoltaic Cell and Module Import Shipments by Country, 2007 and 2008	19
Table 3.13 Export Shipments of Photovoltaic Cells and Modules by Type, 1999 - 2008	20
Table 3.14 Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2007 and 2008	21
Table 3.15 Shipments of Complete Photovoltaic Module Systems, 2006 - 2008.....	23
Table 3.16 Employment in the Photovoltaic Manufacturing Industry, 1999 - 2008	24
Table 3.17 Number of Companies Expecting to Introduce New Photovoltaic Products in 2009.....	25
Table 3.18 Number of Companies Involved in Photovoltaic-Related Activities, 2007 and 2008	26
Table 3.19 Photovoltaic-Related Sales as a Percentage of Total Company Sales Revenue, 2007 and 2008....	27

Illustrations

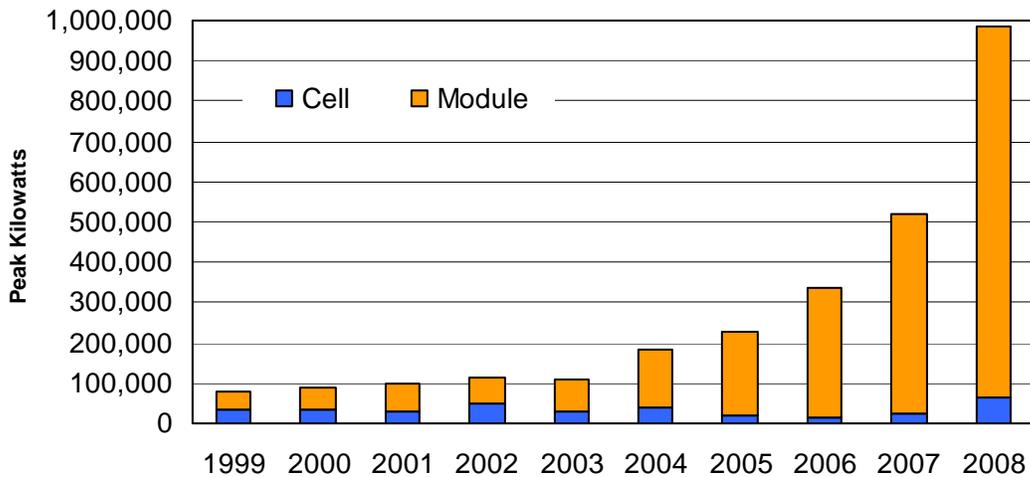
Figure 3.1 Photovoltaic Cell and Module Shipments, 1999-2008	1
Figure 3.2 Photovoltaic Cell and Module Shipments by Type, 2004-2008.....	3
Figure 3.3 Crystalline Silicon Shipment and Thin-Film Shipment Market Shares, 1999-2008	4
Figure 3.4 Photovoltaic Cell and Module Average Prices, 2004-2008	5

Solar Photovoltaic Cell/Module Manufacturing Activities 2008

Overview

Strong growth in the U.S. photovoltaic (PV) industry continued in 2008. Total shipments of PV cells and modules increased more than 90 percent in 2008 (Figure 3.1 and Table 3.1) to nearly 1 million peak kilowatts. This surge in growth was partly due to the 30 percent Federal investment tax credit for commercial photovoltaic projects and the 30 percent investment tax credit, capped at \$2,000 for residential photovoltaic projects, set to expire on December 31, 2008. In response, the solar industry rushed to complete projects by the end of 2008 as the deadline for the investment tax credits drew near. Finally, on October 3, 2008, the President signed the Emergency Economic Stabilization Act of 2008¹ into law, which extended the solar investment tax credits for another eight years.

Figure 3.1 Photovoltaic Cell and Module Shipments, 1999 2008



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

¹ As part of the Emergency Economic Stabilization Act of 2008, the solar investment tax credit (ITC) was extended for eight years, with the following key provisions: extension of the 30% Federal investment tax credit for both residential and commercial solar installations for eight years through December 31, 2016; elimination of the \$2,000 cap on the investment tax credit for residential solar electric installations placed into service after December 31, 2008; and public utilities are now eligible to claim the solar investment tax credits. The Act is available at <http://financialservices.house.gov/eesa.html>.

Industry Status

The number of active PV manufacturers and/or importers that ship PV cells and modules increased more than 43 percent, from 46 companies in 2007 to 66 companies in 2008. This is one indication that the emerging solar market has become attractive to investors desiring to start or expand businesses in this market. During 2008, PV cell and module shipments reached a record high of 986,504 peak kilowatts, a 90-percent increase from 517,684 peak kilowatts in 2007 (Figure 3.1 and Table 3.1).

The companies reporting PV shipments in 2008 also reported being involved in one or more of the following photovoltaic-related activities (Table 3.18):

- 29 companies were involved in module and/or cell manufacturing,
- 39 were designing modules or systems,
- 28 were developing prototype modules,
- 20 were developing prototype systems,
- 37 were involved in wholesale distribution,
- 16 were involved in retail distribution, and
- 28 were offering installation of their products.

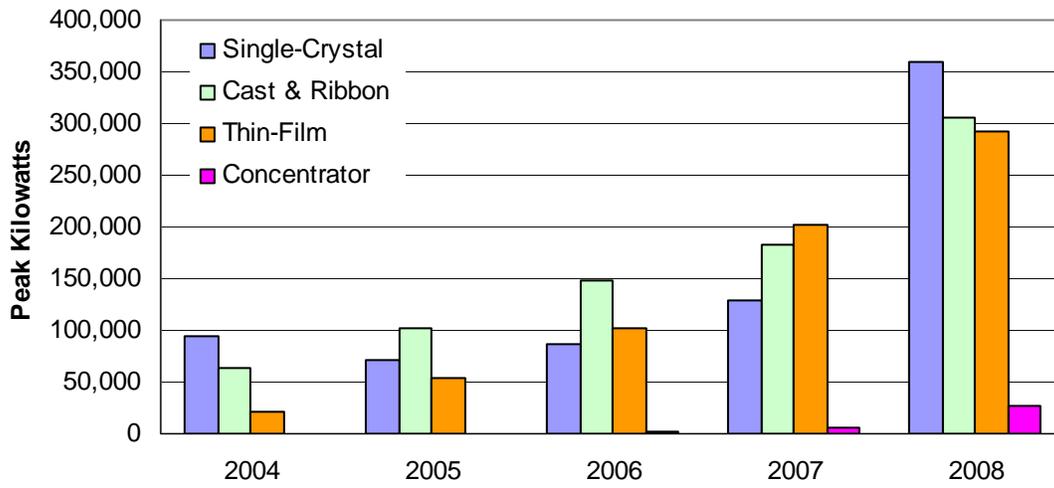
Of the 66 companies active in 2008, 20 are expecting to introduce crystalline silicon products, 11 companies are planning to introduce new thin-film products, and 2 companies are expecting to provide new concentrator photovoltaic (CPV) products in 2009 (Table 3.17). This indicates that many companies believe that stronger government support in the United States will fuel new market expansion. Simultaneously, these companies are preparing to manufacture more-advanced PV technology modules as the PV industry ramps up to meet growing demand and competition.

Corresponding to the strong growth in PV shipments, employment in PV-related activities increased more than 82 percent, from 6,170 person-years in 2007 to 11,245 person-years in 2008 (Table 3.16). Of the 66 companies, 50 had 90 percent or more of their total company-wide revenues in PV-related activities, 7 had 50 to 89 percent, 4 had 10 to 49 percent, and 5 had less than 10 percent (Table 3.19).

PV cells and modules can be made from different semiconductor materials, varying in cost and performance. PV cells and modules are divided into three main categories by product type (Figure 3.2): (1) crystalline silicon, a type of photovoltaic cell/module made from a wedge of single-crystal or polycrystalline silicon, based on crystal-producing processes such as single-crystal, cast, and ribbon; (2) thin-film, photovoltaic cell/module

made from layers of semiconductor material, such as amorphous silicon (a-Si), cadmium telluride (CdTe), or copper indium gallium selenide (CIGS); and (3) concentrator, a type of photovoltaic cell/module including a reflective or refractive device (such as lenses that gather and concentrate sunlight onto the photovoltaic cell).

Figure 3.2 Photovoltaic Cell and Module Shipments by Type, 2004-2008



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

The performance of a photovoltaic cell/module can be described in terms of its energy conversion efficiency, the percentage of incident solar energy (input) that the cell converts to electricity (output) under standard rating conditions. In 2008, the average energy conversion efficiencies were as follows: crystalline silicon (single-crystal) PV cell/module, 19 percent; crystalline silicon (cast) PV cell/module, 14 percent; crystalline silicon (ribbon) PV cell/module, 13 percent; thin-film (amorphous silicon) PV cell/module, 8 percent; thin-film other (special photovoltaic material such as CdTe, and CIGS) PV cell/module, 12 percent; and concentrator PV cell/module, 34 percent (Table 3.8).

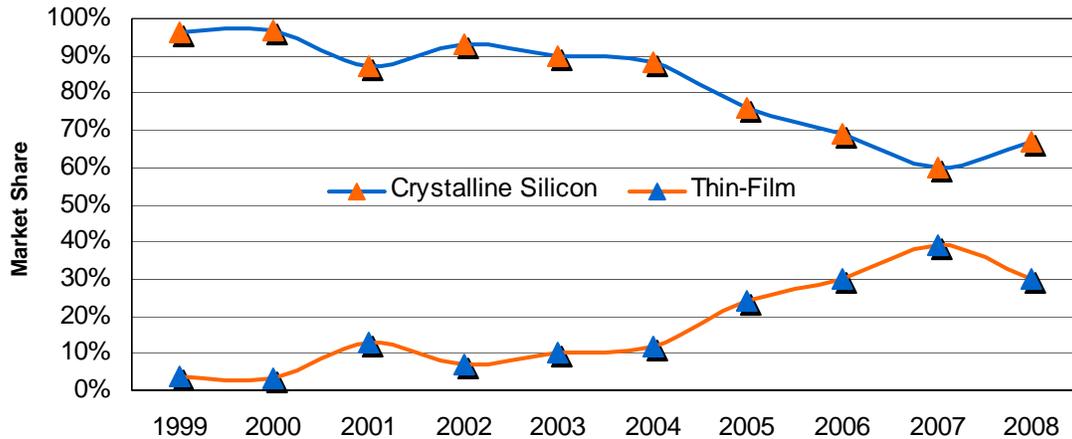
Photovoltaic Cell and Module Shipments

Photovoltaic (PV) cell and module shipments again reached a record high, 986,504 peak kilowatts in 2008. Cell shipments accounted for 65,811 peak kilowatts, while module shipments accounted for 920,693 peak kilowatts (Table 3.3). Not surprisingly, shipments have tripled in the three years since the new Federal Investment Tax Credit (ITC) took effect in January 2006.

Although the thin-film modules shipment market share has grown steadily for many years, crystalline silicon cells and modules continued to dominate the PV industry in

2008, accounting for 67 percent of the total shipments (Figure 3.3 and Table 3.5). The easing shortage of raw high-purity silicon contributed to a more than doubling of crystalline silicon shipments between 2007 and 2008, and led to a slight rebound in market share of crystalline silicon shipments. But crystalline silicon cell and module manufacturers still face a long-term downward trend in market share of previous years. In response to demand and competition, many crystalline silicon cell and module manufacturers have been working to minimize the use of silicon, increase efficiency, and decrease manufacturing cost. This will put the emerging thin-film manufacturers under pressure to compete given their inherently lower efficiency product line.

Figure 3.3 Crystalline Silicon Shipment and Thin-Film Shipment Market Shares, 1999-2008



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

Shipments of single-crystal silicon totaled 359,259 peak kilowatts, an increase of more than 179 percent compared with corresponding 2007 shipments. Cast and ribbon silicon shipments totaled 306,537 peak kilowatts in 2008, nearly a 69-percent increase from the corresponding 2007 shipments. Thin-film shipments increased to 293,182 peak kilowatts in 2008, compared to 202,519 peak kilowatts in 2007. In 2008, thin-film accounted for nearly 30 percent of the market, compared to slightly more than 39 percent in 2007 (Figure 3.3 and Table 3.5).

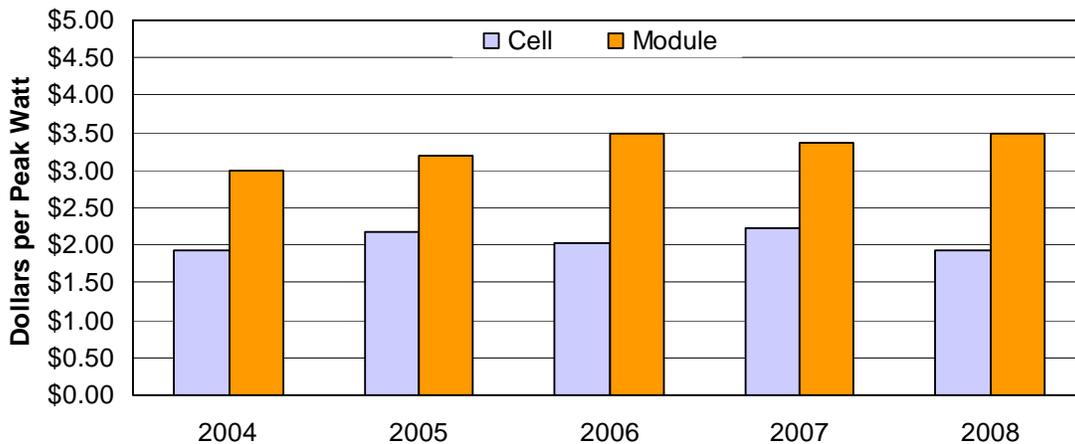
Over the last few years, there has been increasing interest in concentrator photovoltaic (CPV) technology. Although concentrator shipments only accounted for about 3 percent of the total in 2008, the shipments of 27,527 peak kilowatts are noteworthy, representing nearly a six-fold increase when compared with corresponding 2007 shipments (Table 3.5).

Total Revenue and Average Price

Total revenue of photovoltaic cell and module shipments grew nearly 95 percent from \$1.72 billion in 2007 to \$3.34 billion in 2008 (Table 3.6). Revenue includes charges for cooperative advertising and warranties, but does not include excise taxes and the cost of freight or transportation.²

The average price for modules (dollars per peak watt) increased nearly 4 percent, from \$3.37 in 2007 to \$3.49 in 2008 (Figure 3.4). For cells, the average price decreased more than 12 percent, from \$2.22 in 2007 to \$1.94 in 2008.

Figure 3.4 Photovoltaic Cell and Module Average Prices, 2004-2008



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

Domestic Shipments

Despite the economic downturn in the United States, PV shipments grew enormously during 2008. Domestic shipments increased to 524,252 peak kilowatts, nearly 87 percent higher than the 280,475 peak kilowatts in 2007 (Table 3.2).

Domestic shipments to the commercial sector in 2008 accounted for 253,852 peak kilowatts or more than 48 percent of the domestic market. Of the domestic shipments to the commercial sector, 86 percent were crystalline silicon, about 14 percent were thin-film PV, and less than 0.1 percent were concentrator PV (Table 3.7). The residential sector was the second-largest domestic market in 2008, accounting for 173,989 peak kilowatts or about 33 percent of the domestic market share. About 87 percent of its

² See the [EIA glossary](#).

shipments were crystalline silicon shipments and 13 percent were thin-film PV shipments. Shipments to the industrial sector amounted to 51,493 peak kilowatts, or about 10 percent of the domestic market share. Crystalline silicon accounted for 73 percent of the industrial shipments and thin-film PV accounted for 27 percent. The electric power sector, with about 7 percent of domestic shipments, was the fourth-largest domestic sales market, totaling 35,819 peak kilowatts, similar to the 2007 level. About 24 percent were crystalline silicon, 48 percent were thin-film PV, and 28 percent of its shipments were concentrator PV.

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 2008, PV cell and module shipments to the electricity generation market totaled 516,381 peak kilowatts, or more than 98 percent of domestic shipments. Domestic shipments to original equipment manufacturers (OEM) and communication end uses were the second and third-largest end uses, respectively, totaling slightly more than 1 percent. Domestic shipments to consumer goods, transportation, water pumping, and health end users held small market shares, totaling another 1 percent of domestic shipments (Table 3.7).

During 2008, PV shipments to installers, the largest customer type, totaled 231,235 peak kilowatts, 44 percent of the domestic market share. Shipments to the second-largest customer type, wholesale distributors, amounted to 125,527 peak kilowatts, or nearly 24 percent of the domestic market share (Table 3.4).

Complete Systems

A complete PV system is defined as a power supply unit that satisfies all the power requirements of an application. Such a system is made up of different components, including one or more PV modules, a power conditioning unit to process the electricity into the form needed by the application, wires, and other electrical connectors. Batteries for back-up power supply are an option. Some large-scale PV systems use concentrators to focus incident insolation onto small PV cells and tracking systems to track the sun. These large-scale systems convert sunlight directly into electricity and produce the greatest amounts of power during the afternoon, when electricity demand is high.

During 2008, the number of shipments of complete PV systems increased to 20,025 systems from the 10,600 systems in 2007. The total value of complete systems increased nearly 154 percent to \$1.25 billion in 2008. The total peak kilowatts of complete systems shipped surged from 80,560 in 2007 to 202,632 in 2008 (Table 3.15). These statistics indicate companies are becoming more involved in developing larger PV systems with high demand and market growth potential.

³ See the [EIA glossary](#).

Origin of Shipments

Imports of PV cells and modules more than doubled from a year ago to 586,558 peak kilowatts, or 68 percent of total shipments in 2008 (Table 3.11). The predominant type of import shipment was crystalline silicon cells and modules, accounting for almost 95 percent (554,992 peak kilowatts) of total imports. Japan, China, and Philippines accounted for 73 percent of total imports (Table 3.12).

In 2008, about 40 percent of PV cells and modules were manufactured in the United States; manufacturers in Ohio, Michigan, California, Massachusetts, and Maryland produced nearly 88 percent of domestically produced cells and modules (Table 3.9).

Destination of Shipments

Exports of PV cells and modules totaled 462,252 peak kilowatts in 2008, nearly a 95-percent increase from the 2007 exports of 237,209 peak kilowatts (Table 3.13). The predominant type of export shipment was crystalline silicon cells and modules, accounting for slightly more than 52 percent (240,890 peak kilowatts) of total exports. The export market accounted for nearly 47 percent of total shipments and was dominated by sales to Germany (43 percent), Spain (23 percent), and Italy (11 percent) (Table 3.14).

In 2008, a total of 524,252 peak kilowatts of domestic PV cell and module shipments went to all 50 States, the District of Columbia, the Virgin Islands, and Puerto Rico (Table 3.10). About 81 percent of domestic PV cell and module shipments (425,005 peak kilowatts) went to five States: California, New Jersey, Florida, Colorado, and Arizona, with nearly 69 percent (359,761 peak kilowatts) of domestic shipments sent to California and New Jersey.

**Table 3.1 Annual Shipments of Photovoltaic Cells and Modules, 1999 - 2008
(Peak Kilowatts)**

Year	Number of Companies	Photovoltaic Cell and Module Shipments		
		Total	Imports	Exports
1999	19	76,787	4,784	55,585
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
2007	46	517,684	238,018	237,209
2008	66	986,504	586,558	462,252

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 3.2 Annual Photovoltaic Domestic Shipments, 1999 - 2008

(Peak Kilowatts)

Year	Photovoltaic Cells and Modules¹
1999	21,201
2000	19,838
2001	36,310
2002	45,313
2003	48,664
2004	78,346
2005	134,465
2006	206,511
2007	280,475
2008	524,252
U.S. Total	1,395,376

¹Total 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-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

Table 3.3 Annual Photovoltaic Shipments by Cells and Modules, 1999 - 2008

(Peak Kilowatts)

Year	Cells	Modules	Total
1999	33,714	43,073	76,787
2000	33,213	55,007	88,221
2001	30,633	67,033	97,666
2002	47,677	64,413	112,090
2003	29,295	80,062	109,357
2004	37,842	143,274	181,116
2005	21,920	204,996	226,916
2006	17,060	320,208	337,268
2007	23,535	494,148	517,684
2008	65,811	920,693	986,504

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 3.4 Distribution of Domestic Photovoltaic Cells and Modules by Customer Type, 2006 - 2008
(Peak Kilowatts)**

Customer Type	Shipments		
	2006	2007	2008
Wholesale Distributors	-	109,015	125,527
Retail Distributors	-	19,748	44,203
Exporters	-	1,513	888
Installers	-	110,009	231,235
End Users	-	38,686	109,879
Module Manufacturers	-	1,504	12,521
U.S. Total	206,511	280,475	524,252

- = No data reported.

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 3.5 Photovoltaic Cell and Module Shipments by Type, 2006 - 2008

Type	Shipments (Peak Kilowatts)			Percent of Total		
	2006	2007	2008	2006	2007	2008
Crystalline Silicon						
Single-Crystal	85,627	128,542	359,259	25	25	36
Cast and Ribbon	147,892	181,788	306,537	44	35	31
Subtotal	233,518	310,330	665,795	69	60	67
Thin-Film	101,766	202,519	293,182	30	39	30
Concentrator	1,984	4,835	27,527	1	1	3
Other ¹	-	-	-	-	-	-
U.S. Total	337,268	517,684	986,504	100	100	100

¹Other includes categories not identified by reporting companies.

- = No data reported.

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 3.6 Photovoltaic Cell and Module Shipment Revenue by Type, 2007 and 2008

Type	2007			2008		
	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	478,355	3.74	3.06	1,398,140	3.97	2.94
Cast and Ribbon	645,964	3.62	2.65	1,091,526	3.60	2.44
Subtotal	1,124,319	3.67	2.74	2,489,666	3.80	2.80
Thin-Film	W	W	W	826,657	2.82	1.03
Concentrator	W	W	W	26,380	5.74	0.68
Other ¹	-	-	-	-	-	-
U.S. Total	1,716,096	3.37	2.22	3,342,702	3.49	1.94

¹Other includes categories not identified by reporting companies.

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

- = No data reported.

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 3.7 Domestic Shipments of Photovoltaic Cells and Modules by Market Sector, End Use, and Type, 2007 and 2008
(Peak Kilowatts)**

Sector and End Use	Crystalline Silicon ¹	Thin-Film Silicon	Concentrator Silicon	Other ²	2008 Total	2007 Total
Market Sector						
Residential	152,057	21,932	-	-	173,989	68,417
Commercial	217,446	36,396	10	-	253,852	140,434
Industrial	37,702	13,701	90	-	51,493	32,702
Electric Power	8,601	17,158	10,060	-	35,819	35,294
Transportation	9,100	-	-	-	9,100	3,627
U.S. Total	424,906	89,186	10,160	-	524,252	280,475
End Use						
Electricity Generation						
Grid-Interactive	403,283	87,418	10,153	-	500,854	253,101
Remote	14,738	789	-	-	15,527	10,867
Communication	2,546	69	8	-	2,622	2,836
Consumer Goods	160	152	-	-	312	589
Transportation	914	2	-	-	916	4,018
Water Pumping	1,050	95	-	-	1,145	3,852
Cells/Modules to OEM	1,998	661	-	-	2,659	4,802
Health	217	-	-	-	217	410
U.S. Total	424,906	89,186	10,160	-	524,252	280,475

¹Includes single-crystal and cast and ribbon types.

²Other includes categories not identified by reporting companies.

- = No data reported.

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 3.8 Average Energy Conversion Efficiency of Photovoltaic Cells and Modules Shipped, 2007 - 2008

(Percent of Energy Converted)

Year	Crystalline Silicon			Thin-Film Silicon		Concentrator Silicon	Other ¹
	Single-Crystal	Cast	Ribbon	Amorphous Silicon	Other		
2007	17	14	12	8	12	35	-
2008	19	14	13	8	12	34	-

¹Other includes categories not identified by reporting companies.

- = No data reported.

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

**Table 3.9 Shipments of Photovoltaic Cells and Modules by Origin, 2007 and 2008
(Peak Kilowatts)**

Origin	2007	2008
Arizona	6,000	13,583
California	45,236	44,059
Delaware	18,412	15,000
Georgia	-	423
Iowa	1,147	1,143
Maryland	28,323	29,768
Massachusetts	8,264	38,811
Michigan	47,647	109,122
New Jersey	1,578	2,886
New Mexico	2,752	7,427
New York	107	144
Ohio	116,500	133,681
Pennsylvania	3,700	3,900
Shipments from United States/Territories	279,666	399,947
Imports	238,018	586,558
Total Shipments	517,684	986,504

- = No data reported.

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 3.10 Shipments of Photovoltaic Cells and Modules by Destination, 2007 and 2008
(Peak Kilowatts)**

Destination	2007	2008
Alabama	25	92
Alaska	40	37
Arizona	8,198	17,908
Arkansas	14	100
California	180,272	327,788
Colorado	14,178	22,624
Connecticut	813	8,085
Delaware	754	1,008
District of Columbia	6	795
Florida	6,342	24,713
Georgia	138	473
Hawaii	3,085	7,879
Idaho	56	118
Illinois	396	1,443
Indiana	277	693
Iowa	50	74
Kansas	52	68
Kentucky	12	64
Louisiana	132	431
Maine	116	172
Maryland	1,068	9,451
Massachusetts	2,904	5,029
Michigan	140	365
Minnesota	381	234
Mississippi	2	15
Missouri	221	403
Montana	439	470
Nebraska	41	55
Nevada	28,759	14,330
New Hampshire	517	842
New Jersey	10,305	31,973
New Mexico	1,529	3,387
New York	4,536	11,813
North Carolina	985	2,674
North Dakota	23	13
Ohio	229	969
Oklahoma	264	364
Oregon	1,640	6,782
Pennsylvania	953	1,563
Puerto Rico	10	170
Rhode Island	765	87
South Carolina	250	106
South Dakota	34	31
Tennessee	53	155
Texas	6,048	8,778
Utah	113	314
Vermont	1,443	5,257
Virgin Islands of the U.S.	1	22
Virginia	174	379
Washington	668	1,988
West Virginia	52	72
Wisconsin	828	1,490
Wyoming	147	107
Shipments to United States/Territories	280,475	524,252
Exported	237,209	462,252
Total Shipments	517,684	986,504

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 3.11 Import Shipments of Photovoltaic Cells and Modules by Type, 1999 - 2008**(Peak Kilowatts)**

Item/Year	Crystalline Silicon	Thin-Film Silicon	Concentrator Silicon	Other ¹	Total
Cells					
1999	150	4	-	-	154
2000	3,779	3	24	-	3,805
2001	3,169	6	-	-	3,175
2002	915	4	-	-	919
2003	439	3	-	-	442
2004	33,607	-	-	-	33,607
2005	46,538	-	-	-	46,538
2006	74,290	-	-	-	74,290
2007	64,757	-	95	-	64,852
2008	136,740	5	-	-	136,745
Modules					
1999	3,530	1,100	-	-	4,630
2000	4,383	633	-	-	5,016
2001	6,681	348	-	-	7,029
2002	6,119	259	-	-	6,378
2003	9,027	262	-	-	9,289
2004	14,096	-	-	-	14,096
2005	33,081	11,337	25	-	44,443
2006	84,308	14,170	1,209	-	99,687
2007	149,699	23,466	-	-	173,165
2008	418,252	30,661	900	-	449,813
Totals					
1999	3,680	1,104	-	-	4,784
2000	8,161	636	24	-	8,821
2001	9,850	354	-	-	10,204
2002	7,034	263	-	-	7,297
2003	9,466	265	-	-	9,731
2004	47,703	-	-	-	47,703
2005	79,619	11,337	25	-	90,981
2006	158,598	14,170	1,209	-	173,977
2007	214,457	23,466	95	-	238,018
2008	554,992	30,666	900	-	586,558

¹Other includes categories not identified by reporting companies.

- = No data reported.

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 3.12 Origin of U.S. Photovoltaic Cell and Module Import Shipments by Country, 2007 and 2008
(Peak Kilowatts)**

Region/Country	2007	2008	Percent of U.S. Imports 2008
Asia			
China	59,405	133,038	22.68
Hong Kong	3,429	6,200	1.06
India	4,976	1,096	0.19
Japan	102,791	145,745	24.85
Philippines	364	150,092	25.59
Taiwan	583	44,889	7.65
Total	171,547	481,060	82.01
Central America			
Mexico	23,961	43,440	7.41
Total	23,961	43,440	7.41
Europe			
Federal Republic of Germany	41,265	58,517	9.98
Spain	-	3,540	0.60
United Kingdom	4	-	-
Total	41,268	62,057	10.58
North America			
Canada	1,241	-	-
Total	1,241	-	-
U.S. Total	238,018	586,558	100.00

- = No data reported.

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 3.13 Export Shipments of Photovoltaic Cells and Modules by Type, 1999 - 2008

(Peak Kilowatts)

Item/Year	Crystalline Silicon	Thin-Film Silicon	Concentrator Silicon	Other ¹	Total
Cells					
1999	31,031	-	9	-	31,040
2000	32,019	-	86	-	32,105
2001	26,899	-	174	-	27,073
2002	33,952	-	267	-	34,219
2003	30,337	-	127	-	30,464
2004	36,492	-	-	-	36,492
2005	20,434	-	-	-	20,434
2006	12,960	838	400	-	14,198
2007	16,592	1,500	3,753	-	21,845
2008	36,419	605	15,967	-	52,991
Modules					
1999	23,587	958	-	-	24,545
2000	35,440	837	-	-	36,277
2001	29,660	4,622	-	-	34,282
2002	29,987	2,572	-	-	32,559
2003	25,190	5,039	-	-	30,229
2004	52,938	13,341	-	-	66,278
2005	39,992	32,000	25	-	72,017
2006	47,681	68,880	-	-	116,561
2007	66,791	148,477	95	-	215,364
2008	204,471	203,391	1,400	-	409,261
Totals					
1999	54,618	958	9	-	55,585
2000	67,460	837	86	-	68,382
2001	56,559	4,622	174	-	61,356
2002	63,939	2,572	267	-	66,778
2003	55,527	5,039	127	-	60,693
2004	89,430	13,341	-	-	102,770
2005	60,426	32,000	25	-	92,451
2006	60,640	69,718	400	-	130,757
2007	83,383	149,977	3,848	-	237,209
2008	240,890	203,996	17,367	-	462,252

¹Other includes categories not identified by reporting companies.

- = No data reported.

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 3.14 Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2007 and 2008
(Peak Kilowatts)**

Region/Country	2007	2008	Percent of U.S. Exports 2008
Africa			
Angola	s	-	-
Gambia	1	-	-
Kenya	17	416	0.09
Namibia	38	-	-
Nigeria	174	400	0.09
South Africa	619	1,162	0.25
Tanzania	42	-	-
Uganda	27	-	-
Total	918	1,978	0.43
Asia			
Afghanistan	147	76	0.02
Bahrain	-	1	*
Cambodia	156	624	0.13
China	7,238	4,418	0.96
Hong Kong	5,427	4,120	0.89
India	2,795	1,137	0.25
Indonesia	-	176	0.04
Israel	174	149	0.03
Japan	1,032	440	0.10
Korea, South	3,444	10,763	2.33
Malaysia	4	19	*
Oman	14	24	*
Saudi Arabia	11	-	-
Singapore	698	12,297	2.66
Taiwan	1,111	700	0.15
Thailand	-	14	*
United Arab Emirates	18	234	0.05
Total	22,269	35,192	7.61
Australia & Oceania			
Australia	2,757	8,108	1.75
French Polynesia	15	-	-
New Zealand	9	48	0.01
Total	2,781	8,156	1.76
Central America			
Bahamas	-	100	0.02
Belize	-	7	*
Bermuda	1	-	-
British Virgin Islands	6	-	-
Cayman Islands	-	3	*
Costa Rica	-	16	*
Dominica	-	5	*
Dominican Republic	33	159	0.03
El Salvador	-	2	*
Guatemala	3	16	*
Haiti	20	225	0.05
Honduras	26	61	0.01
Jamaica	43	50	0.01
Martinique	1	-	-
Mexico	116	564	0.12
Nicaragua	30	139	0.03
Panama	4	134	0.03
Trinidad and Tobago	4	4	*
Total	288	1,484	0.32
Europe			
Albania	-	481	0.10
Austria	118	4,155	0.90

Table 3.14 Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2007 and 2008 (Peak Kilowatts) (Continued)

Region/Country	2007	2008	Percent of U.S. Exports 2008
Belgium	147	2,148	0.46
Bulgaria	15	541	0.12
Czech Republic	-	592	0.13
Denmark	-	101	0.02
Federal Republic of Germany	152,654	198,230	42.88
Finland	10	1	*
France	10,228	31,196	6.75
Greece	-	487	0.11
Hungary	-	512	0.11
Iceland	1	-	-
Ireland	-	17	*
Italy	10,364	49,830	10.78
Kazakhstan	-	1	*
Netherlands	451	20	*
Norway	292	-	-
Poland	-	482	0.10
Portugal	647	10	*
Romania	-	482	0.10
Russia	-	2	*
Slovakia	5	-	-
Spain	31,384	105,555	22.84
Sweden	1,333	1,131	0.24
Switzerland	109	383	0.08
Turkey	-	3	*
United Kingdom	11	50	0.01
Total	207,768	396,410	85.76
North America			
Canada	1,246	17,819	3.85
Total	1,246	17,819	3.85
South America			
Argentina	90	5	*
Bolivia	89	135	0.03
Brazil	1,359	652	0.14
Chile	140	145	0.03
Colombia	52	97	0.02
Ecuador	58	21	*
Peru	141	152	0.03
Uruguay	-	8	*
Venezuela	9	-	-
Total	1,939	1,214	0.26
U.S. Total	237,209	462,252	100.00

* = Less than 0.01 percent.

s = Value is less than 0.5 of the table metric, but value is included in any associated total.

- = No data reported.

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 3.15 Shipments of Complete Photovoltaic Module Systems, 2006 - 2008

Shipment Information	2006	2007	2008
Complete Photovoltaic Module Systems Shipped	67,172	10,600	20,025
Peak Kilowatts	28,099	80,560	202,632
Percentage of Total Module Shipments	9	16	22
Revenue of Systems (Thousand Dollars)	192,928	491,740	1,246,126

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 3.16 Employment in the Photovoltaic Manufacturing Industry, 1999 - 2008

Year	Number of Companies	Number of Person-Years
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
2007	46	6,170
2008	66	11,245

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

Table 3.17 Number of Companies Expecting to Introduce New Photovoltaic Products in 2009

New Product Type	Number of Companies
Crystalline Silicon	
Single-Crystal Silicon Modules	10
Cast Silicon Modules	8
Ribbon Silicon Modules	2
Thin-Film	
Amorphous Silicon Modules	5
Other (Thin Film)	6
Concentrators	2
Nonmodule System Components	3

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

Table 3.18 Number of Companies Involved in Photovoltaic-Related Activities, 2007 and 2008

Type of Activity	Number of Companies	
	2007	2008
Module or Cell Manufacturing	24	29
Module or Systems Design	25	39
Prototype Module Development	16	28
Prototype Systems Development	13	20
Wholesale Distribution	25	37
Retail Distribution	14	16
Installation	13	28
Noncollector System Component Manufacture	6	9

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

Table 3.19 Photovoltaic-Related Sales as a Percentage of Total Company Sales Revenue, 2007 and 2008

Percent of Total Sales Revenue	Number of Companies	
	2007	2008
90-100	28	50
50-89	7	7
10-49	7	4
Less than 10	4	5
U.S. Total	46	66

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