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Geothermal Heat Pump Manufacturing Activities 2007

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Preface

The Energy Information Administration (EIA) reports detailed historical data on geothermal heat pump manufacturing activities annually in its report, the *Renewable Energy Annual*. This report, *Geothermal Heat Pump Manufacturing Activities*, provides an overview and tables with historical data spanning 1999-2007, as well as the revised methodology used to collect information from all manufacturers of renewable energy equipment for 2007, so that the methodology across EIA is uniform. Changes included adding "Manufacturing Status," "Manufacturer and Marketing Data," "Total Revenue of GHP Shipments," "Imports," "Exports," "Shipments by Origin," "Shipments by Destination," and collecting "Domestic Shipments by Sector, End Use, and Customer Type," instead of "Total Shipments by Sector, End Use, and Customer Type." All tables will correspond to similar tables to be presented in *Renewable Energy Annual 2007* and are numbered accordingly.

Data in this report is based upon manufacturing shipment information reported on Form EIA-902, "Annual Geothermal Heat Pump 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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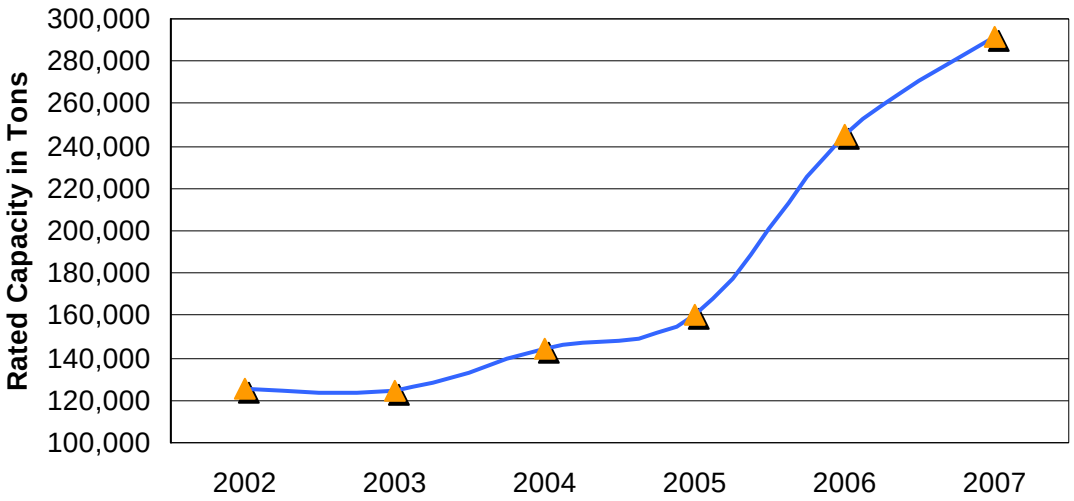
Overview

For the past four years, the U.S. Geothermal Heat Pump (GHP) industry has seen double-digit growth each year, fueled in part by the soaring energy prices for traditional fuels as well as the desire for reliable and clean energy alternatives. In 2007, total geothermal heat pump shipments surged 36 percent to 86,396 units (Table 4.1), while capacity shipped rose 19 percent to 291,300 tons (Table 4.2). While 2007 capacity growth was substantial, it was below growth in 2006, which was 53 percent. Total rated capacity of geothermal heat pumps shipped in 2006 was 245,603 tons, compared to 160,402 tons in 2005 (Table 4.2 and Figure 4.1). Despite costing more initially than traditional heating and cooling systems, the high efficiency and ongoing cost-saving potential of GHP has resulted in GHP becoming the heating and cooling system of choice for many consumers.

Figure 4.1 Geothermal Heat Pump Shipments, 2002-2007



Source: Energy Information Administration (EIA)
Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Industry Status

In 2007, there were about 17 known domestic manufacturers of geothermal heat pumps, including brand-name manufacturers[1] that shipped geothermal heat pumps manufactured by others under contract.

[1] Brand name manufacturer is defined as a name used to identify a product in the consumer marketplace, which attributes the product to the owner of the name as the manufacturer.

Almost all manufacturers have their geothermal heat pumps tested and certified by the Air Conditioning, Heating, and Refrigeration Institute (AHRI) for their cooling capacities and their operating efficiencies. In general, geothermal heat pumps are rated based on one of the four standards by the AHRI. These standards are ARI-320 (ARI/ISO 13256-1 Water-Source Heat Pumps), ARI-325 (ARI/ISO 13256-1 Ground Water-Source Heat Pumps), ARI-330 (ARI/ISO 13256-1 Ground-Source Heat Pumps), and ARI-870 (Direct Geoexchange Heat Pumps) [2].

Out of 86,369 GHP units shipped in 2007, a total of 8,112 were ARI-320 rated, 66,863 were ARI-325 or ARI-330 rated, and 809 were ARI-870 rated. ARI-rated shipments increased to 75,784 units in 2007, while the number of other non-rated units shipped more than doubled to 10,612 in 2007 (Table 4.1).

The manufacturers reporting GHP shipments in 2007 also reported being involved in one or more of the following geothermal heat pump-related activities (Table 4.15):

- A total of 12 manufacturers were involved in the design of geothermal heat pumps or systems,
- 10 were developing prototype geothermal heat pumps only,
- 4 were developing prototype systems, which include pumps and other components,
- 12 were involved in wholesale distribution,
- 4 were involved in retail distribution,
- 3 were offering installation of their GHP products, and
- 2 were involved in the manufacture of system components.

Of the 17 manufacturers active in 2007, 6 are planning to introduce new ARI-320 rated water-source heat pumps, 6 are planning new ARI-325 rated ground water-source heat pumps, 8 are planning to introduce new ARI-330 rated ground source closed-loop heat pumps, and 1 is expecting to introduce new ARI-870 rated direct geoexchange heat pumps in 2008 (Table 4.13). These statistics indicate that increasing public demand for alternative energy systems has created business opportunities for the geothermal heating and cooling industry.

In 2007, direct employment in the geothermal heat pump manufacturer industry accounted for 1,219 person-years[3] (Table 4.14). Of the 17 manufacturers, 8 had 90

[2] For explanation of ARI standards 320, 325, 330, and 870 see survey form instructions at http://www.eia.doe.gov/cneaf/solar.renewables/page/forms/inst902.pdf.

[3] See the EIA glossary.

percent or more of their total company-wide revenues in geothermal heat pump-related activities, 1 had 50 to 89 percent, 4 had 10 to 49 percent, and 4 manufacturers had less than 10 percent (Table 4.16).

Direct use geothermal energy (e.g., low-temperature water from conventional geothermal sources for crop drying) and energy consumed by GHP both increased in 2007. GHP energy consumption increased 15 percent in 2007 to an estimated 32 trillion Btu, while direct use inched upward from 9.1 to 9.4 trillion Btu (Table 4.17)[4].

Geothermal Heat Pump Shipments

The total rated capacity of geothermal heat pumps shipped in 2007 was 291,300 tons, approximately 19 percent more than the 2006 shipments of 245,603 tons (Table 4.2). The average unit size shipped in 2007 was 3.37 tons, compared to an average unit size of 3.86 tons in 2006 (Table 4.1 and Table 4.2).

In 2007, water-source heat pump (ARI-320 rated) shipments totaled 15,667 tons, which is almost 50 percent less than water-source heat pump shipments in 2006 (Figure 4.2 and Table 4.2). The decrease occurred because one manufacturer classified its equipment differently in 2007 than in 2006.

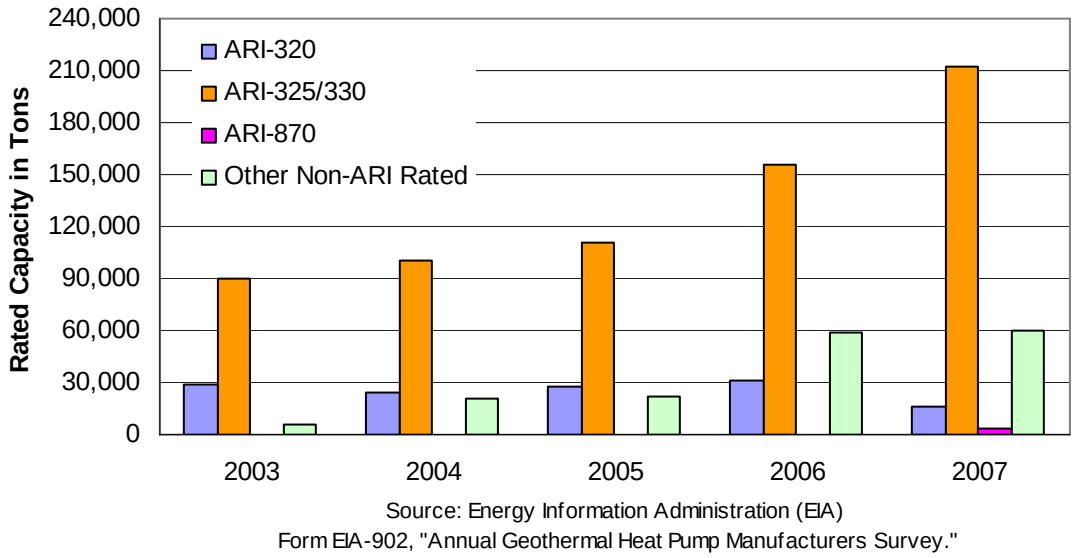
Shipments of ground water-source heat pumps and ground-source heat pumps (ARI-325/330 rated) continued to dominate the GHP industry in 2007, accounting for 73 percent of the total shipments (Figure 4.2 and Table 4.2). The shipments of ARI-325 and ARI-330 were 212,739 tons, a 37 percent increase from the corresponding 2006 shipments.

Shipments of direct geoexchange heat pump (ARI-870 Rated) totaled 3,412 tons in 2007 (Figure 4.2 and Table 4.2).

Despite a doubling of unit sales, capacity of non-ARI rated heat pump shipments in 2007 rose only slightly more than 1 percent (59,482 tons) over 2006 shipments (Figure 4.2 and Table 4.2).

[4] Data provided by Dr. John W. Lund, Oregon Institute of Technology, Geo Heat Center.

Figure 4.2 Geothermal Heat Pump Shipments by Model Type, 2003-2007



Source: Energy Information Administration (EIA)
Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Total Revenue and Average Price

The total revenue for shipments of geothermal thermal heat pumps was approximately $219 million in 2007 (Table 4.5). Revenue includes charges for cooperative advertising and warranties, but does not include excise taxes and the cost of freight or transportation.

The average price (dollars per ton) for water-source heat pumps (ARI-320 rated) was $735.60, ground water-source heat pumps and ground-source heat pumps (ARI-325/330 rated) was $781.08, direct geoexchange heat pumps (ARI-870 rated) was $1,002.36, and other non-ARI rated heat pumps was $636.50 (Table 4.5).

Domestic Shipments

As prices for electricity, natural gas and heating oil continue to rise, geothermal heat pumps for heating and cooling are becoming increasingly viable. During 2007, domestic shipments continued to surge rapidly, with rated capacity totaling 238,870 tons, an 11 percent increase from 215,166 tons in 2006 (Table 4.6).

During 2007, GHP shipments to domestic wholesale distributors, the largest customer category, totaled 130,275 tons or 55 percent of the domestic market share. Shipments to the second-largest customer category, installers, amounted to 102,241 tons, or 43 percent of the domestic market share (Table 4.10).

In 2007, domestic shipments to the residential sector accounted for 110,115 tons or 46 percent of the domestic market. Of the domestic shipments to the residential sector, 2 percent were ARI-320 rated, 89 percent were ARI-325/330 rated, 3 percent were ARI-

870 rated, and 6 percent were non-ARI rated (Table 4.11). The commercial sector was the largest domestic market in the United States in 2007, accounting for 122,699 tons or more than 51 percent of the domestic market share. Ten percent of the purchases for this sector were ARI-320 rated GHP, more than 68 percent ARI-325/330 rated GHP, less than 0.2 percent ARI-870 rated GHP, and about 21 percent non-ARI rated GHP. The industrial sector, with less than 3 percent of domestic shipments, was the smallest domestic market.

Complete Systems

In general, geothermal heating/cooling systems provide space heating and cooling, as well as water heating. A complete geothermal heating/cooling system is defined as a unit with all the necessary functional components, except for installation materials. The system includes three principal components (listed below) and a device called "desuperheaters" which can be added to provide hot water when the system is providing heat or air conditioning.

- Geothermal earth connection subsystem: Using the earth as the heat source and heat sink, this subsystem consists of a series of pipes which are commonly called a "loop." They carry a fluid used to connect the geothermal system's heat pump to the earth near the building to be conditioned.

- Geothermal heat pump subsystem: An electric heat pump that exchanges heat between the fluid and the air that conditions the building.

- Geothermal heat distribution subsystem: An air-delivery system that delivers the conditioned air to the building.

Of the manufacturers reporting 2007 shipments, the majority of these manufacturers sell only geothermal heat pump subsystems (geothermal heat pump units), and only two manufacturers reported selling complete systems. These systems accounted for 623 tons, or 0.2 percent of total GHP shipped in 2007 (Table 4.12).

Origin of Shipments

During the year 2007, there were no GHP import shipments reported. All GHP units (a total of 291,300 tons) were manufactured in the United States. The top five manufacturing states were: Florida, Indiana, Michigan, Oklahoma, and Texas, with 54 percent (157,958 tons) of the total shipped from Indiana and Oklahoma (Table 4.8).

Destination of Shipments

Exports of GHP shipments totaled 52,430 tons in 2007. The export market accounted for 18 percent of total shipments and was dominated by sales to Canada, with 61 percent (32,104 tons) of total exports (Table 4.7).

In 2007, a total of 238,870 tons of domestic GHP shipments went to all 50 States and the District of Columbia (Table 4.6). About 52 percent of domestic GHP shipments (124,152 tons) went to ten States: Florida, Illinois, Indiana, Kentucky, Maryland, New York, Ohio, Oklahoma, Pennsylvania, and Virginia, with 15 percent (36,470 tons) of the total shipments sent to Illinois and New York.

Table 4.1 Geothermal Heat Pump Shipments by Model Type, 1999 - 2007

(Number of Units)

Year	Model Type				
	ARI-320	ARI-325/330	ARI-870	Other Non-ARI Rated	Total
1999	7,910	31,631	-	2,138	41,679
2000	7,808	26,219	-	1,554	35,581
2001	NA	NA	NA	NA	NA
2002	6,445	26,802	-	3,892	37,139
2003	10,306	25,211	-	922	36,439
2004	9,130	31,855	-	2,821	43,806
2005	9,411	34,861	-	3,558	47,830
2006	10,968	47,440	-	5,274	63,682
2007	8,112	66,863	809	10,612	86,396

NA = Not available. No survey was conducted for 2001

- = No data reported.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.2 Rated Capacity of Geothermal Heat Pump Shipments by Model Type, 1999 - 2007
(Tons)

Year	Model Type				
	ARI-320	ARI-325/330	ARI-870	Other Non-ARI Rated	Total
1999	27,970	153,947	-	9,735	191,651
2000	26,469	130,132	-	7,590	164,191
2001	NA	NA	NA	NA	NA
2002	16,756	96,541	-	12,000	125,297
2003	29,238	89,731	-	5,469	124,438
2004	23,764	100,317	-	20,220	144,301
2005	28,064	110,291	-	22,047	160,402
2006	31,198	155,736	-	58,669	245,603
2007	15,667	212,739	3,412	59,482	291,300

NA = Not available. No survey was conducted for 2001
- = No data reported.
Note: One ton of capacity is equal to 12,000 Btus per hour.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.3 Average Cooling Efficiency for Geothermal Heat Pump Shipments, 2006 and 2007
(Average EER)

Year	Model Type			
	ARI-320	ARI-325/330	ARI-870	Other Non-ARI Rated
2006	12.9	19.3	-	13.1
2007	12.5	18.1	18.4	13.2

- = No data reported.

Notes: One ton of capacity is equal to 12,000 Btus per hour.
Efficiency is expressed as btus of output per watthours of input. The higher the EER the more efficient the unit is.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.4 Average Heating Efficiency for Geothermal Heat Pump Shipments, 2006 and 2007 (Average COP)

Year	Model Type			
	ARI-320	ARI-325/330	ARI-870	Other Non-ARI Rated
2006	4.4	3.9	-	3.4
2007	4.1	3.9	4.2	3.7

- = No data reported.

Notes: One ton of capacity is equal to 12,000 Btus per hour.
Efficiency is expressed as btus of output per watthours of input. The higher the COP the more efficient the unit is.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.5 Geothermal Heat Pump Shipments by Model Type, Quantity, Revenue, and Average Price, 2006 and 2007

Model Type	2006			2007		
	Quantity (Rated Capacity in Tons)	Revenue (Thousand Dollars)	Average Price (Dollars per Ton)	Quantity (Rated Capacity in Tons)	Revenue (Thousand Dollars)	Average Price (Dollars per Ton)
ARI-320 GHP Only	31,198	-	-	15,667	11,525	735.60
ARI-325/330	155,736	-	-	212,739	166,167	781.08
ARI-870	-	-	-	3,412	3,420	1,002.36
Other (Non-ARI Rated)	58,669	-	-	59,482	37,860	636.50
U.S. Total	**245,603**	**-**	**-**	**291,300**	**218,972**	**751.70**

- = No data reported.
Notes: Totals may not equal sum of components due to independent rounding.
One ton of capacity is equal to 12,000 Btus per hour.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.6 Geothermal Heat Pump Shipments by Destination, 2006 and 2007
(Rated Capacity in Tons)

Destination	2006	2007
Alabama	1,513	1,259
Alaska	15	5
Arizona	3,896	4,926
Arkansas	2,897	3,028
California	8,918	5,499
Colorado	2,752	4,899
Connecticut	1,240	3,101
Delaware	794	1,464
District of Columbia	2,453	1,432
Florida	15,522	9,841
Georgia	2,707	3,744
Hawaii	125	15
Idaho	1,239	327
Illinois	17,175	20,296
Indiana	12,277	11,118
Iowa	8,214	8,288
Kansas	1,712	2,094
Kentucky	6,196	9,632
Louisiana	1,488	1,704
Maine	398	103
Maryland	7,286	9,472
Massachusetts	2,089	4,188
Michigan	10,653	6,031
Minnesota	7,048	7,669
Mississippi	482	545
Missouri	6,635	4,123
Montana	903	623
Nebraska	4,426	5,456
Nevada	4,559	1,371
New Hampshire	891	2,406
New Jersey	2,720	2,807
New Mexico	534	1,296
New York	12,210	16,174
North Carolina	2,439	2,527
North Dakota	1,388	2,044
Ohio	11,715	14,304
Oklahoma	4,940	9,210
Oregon	1,407	1,671
Pennsylvania	9,997	15,032
Puerto Rico	3	-
Rhode Island	147	93
South Carolina	2,854	3,403
South Dakota	629	744
Tennessee	4,255	8,200
Texas	7,687	8,719
Utah	2,411	2,167
Vermont	414	61
Virgin Islands of the U.S.	13	-
Virginia	7,331	9,073
Washington	2,203	2,980
West Virginia	465	289
Wisconsin	2,812	3,135
Wyoming	89	282
Shipments to United States/Territories	215,166	238,870
Exported	30,437	52,430
Total Shipments	**245,603**	**291,300**

Table 4.6 Geothermal Heat Pump Shipments by Destination, 2006 and 2007 (Rated Capacity in Tons) (Continued)

Destination	2006	2007

- = No data reported.
Note: "Export" in Table 4.6 and "Exporter" in Table 4.10 are different. "Export" refers to shipments outside of the country, while "Exporter" is the type of customer.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.7 Distribution of U.S. Geothermal Heat Pump Exports by Country of Destination, 2006 and 2007
(Rated Capacity in Tons)

Region/Country	2006	2007	Percent of U.S. Exports 2007
Asia			
China	-	110	0.21
India	-	15	0.03
Korea, South	-	2,180	4.16
Palestinian Authority	-	8	0.02
Total	-	2,313	4.41
Australia & Oceania			
Australia	-	5,186	9.89
Total	-	5,186	9.89
Central America			
Mexico	-	342	0.65
Total	-	342	0.65
Europe			
Czech Republic	-	181	0.35
Estonia	-	20	0.04
Italy	-	1,863	3.55
Latvia	-	69	0.13
Lithuania	-	152	0.29
Poland	-	970	1.85
Romania	-	426	0.81
Russia	-	905	1.73
Spain	-	55	0.10
Turkey	-	75	0.14
United Kingdom	-	7,769	14.82
Total	-	12,485	23.81
North America			
Canada	-	32,104	61.23
Total	-	32,104	61.23
U.S. Total	**-**	**52,430**	**100.00**

- = No data reported.

Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.8 Geothermal Heat Pump Shipments by Origin, 2006 and 2007
(Rated Capacity in Tons)

Origin	2006	2007
Arkansas	-	1,867
Florida	-	44,328
Indiana	-	99,166
Michigan	-	30,179
Minnesota	-	8,524
Ohio	-	2,401
Oklahoma	-	58,792
Pennsylvania	-	943
Tennessee	-	581
Texas	-	44,519
Shipments from United States/Territories	-	291,300
Imported	-	-
Total Shipments	**-**	**291,300**

- = No data reported.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.9 Distribution of U.S. Geothermal Heat Pump Imports by Country of Origin, 2006 and 2007
(Rated Capacity in Tons)

Region/Country	2006	2007	Percent of U.S. Imports 2007
U.S. Total	-	-	-

- = No data reported.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.10 Geothermal Heat Pump Domestic Shipments by Customer Type and Model Type, 2006 and 2007
(Rated Capacity in Tons)

Customer	2006	2007
Exporter	206	91
Wholesale Distributor	130,342	130,275
Retail Distributor	1,566	5,629
Installer	82,721	102,241
End-User	331	634
U.S. Total	**215,166**	**238,870**

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.11 Geothermal Heat Pump Domestic Shipments by Sector and Model Type, 2007
(Rated Capacity in Tons)

Destination	Model Type				
	ARI-320	ARI-325/330	ARI-870	Other Non-ARI Rated	Total
Residential	2,210	98,026	2,911	6,968	110,115
Commercial[1]	12,461	83,934	192	26,112	122,699
Industrial	-	70	-	5,986	6,056
Electric Power	-	-	-	-	-
Transportation	-	-	-	-	-
U.S. Total	**14,671**	**182,030**	**3,103**	**39,066**	**238,870**

[1]Including government.
- = No data reported.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.12 Shipments of Complete Geothermal Heating/Cooling Systems, 2006 and 2007

Shipments Information	2006	2007
Complete Systems		
Shipped	-	157
Rated Capacity (Tons)	-	623
Percent of Total Shipments	-	s
Number of Companies	-	2
Revenue of Systems (Thousand Dollars)	-	W

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

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

- = No data reported.

Note: Complete geothermal heating/cooling system is defined as geothermal heat pump unit with all the necessary functional components, except for installation materials. These include geothermal heat pump, air handler, heat exchanger, and system kits.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.13 Number of Companies Expecting to Introduce New Geothermal Heat Pump Products in 2008

New Product Type	Number of Companies
ARI-320 Water-Source Heat Pumps	6
ARI-325 Ground Water-Source Heat Pumps	6
ARI-330 Ground Source Closed-Loop Heat Pumps	8
ARI-870 Direct Geoexhange Heat Pumps	1
Other (Non-ARI Rated)	3
Non-Geothermal Heat Pump System Components	-

- = No data reported.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.14 Employment in the Geothermal Heat Pump Industry, 1998 - 2007

Year	Person Years
1998	-
1999	-
2000	-
2002	-
2003	-
2004	-
2005	-
2006	-
2007	1,219

- = No data reported.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.15 Companies Involved in Geothermal Heat Pump Activities by Type, 2006 and 2007

Type of Activity	2006	2007
Geothermal Heat Pump or System Design	-	12
Prototype Geothermal Heat Pump Development	-	10
Prototype Systems Geothermal Development	-	4
Wholesale Distribution	-	12
Retail Distribution	-	4
Installation	-	3
Manufacture of System Components	-	2

- = No data reported.
Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.16 Geothermal Heat Pump-Related Sales as a Percentage of Total Company Sales Revenue, 2006 and 2007

Percent of Total Sales Revenue	Number of Companies	
	2006	2007
90-100	-	8
50-89	-	1
10-49	-	4
Less than 10	-	4
U.S. Total	**-**	**17**

- = No data reported.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

Table 4.17 Geothermal Direct Use of Energy and Heat Pumps, 1990 - 2007
(Quadrillion Btu)

Year	Direct Use	Heat Pumps	Total
1990	0.0048	0.0054	0.0102
1991	0.0050	0.0060	0.0110
1992	0.0051	0.0067	0.0118
1993	0.0053	0.0072	0.0125
1994	0.0056	0.0076	0.0132
1995	0.0058	0.0083	0.0141
1996	0.0059	0.0093	0.0152
1997	0.0061	0.0101	0.0162
1998	0.0063	0.0115	0.0178
1999	0.0079	0.0114	0.0193
2000	0.0084	0.0122	0.0206
2001	0.0090	0.0135	0.0225
2002	0.0090	0.0147	0.0237
2003	0.0086	0.0188	0.0274
2004	0.0086	0.0212	0.0298
2005	0.0088	0.0240	0.0328
2006	0.0091	0.0276	0.0367
2007	0.0094	0.0317	0.0411

Note: Direct use includes applications such as: district heating, aquaculture pond and raceway heating, greenhouse heating and agricultural drying.
Source: John Lund, Oregon Institute of Technology, Geo-Heat Center (Klamath Falls, Oregon, March 2008).