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An Economic Analysis of the U.S. HVACR and Water Heating Industry

A Preliminary Report Prepared for the
Air-Conditioning, Heating, & Refrigeration Institute

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Preliminary Report

An Economic Analysis of the U.S. HVACR and Water Heating Industry

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Abbreviations

BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
CEW	Census of Employment and Wages
EC	Economic Census
GDP	Gross domestic product
HVACR	Heating, Ventilation, Air-Conditioning and Refrigeration
INFORUM	Interindustry Forecasting at the University of Maryland
IO	Input-Output
NAICS	North American Industry Classification System
NAM	National Association of Manufacturers
OES	Occupational Employment Statistics

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Executive Summary

This report presents a current snapshot and summary of the recent economic evolution of the heating, ventilation, air-conditioning, and refrigeration (HVACR) and water heating industry.

The HVACR manufacturing industry serves many basic requirements of the household, industry, and commercial sectors. These include home and building climate control, supply of hot water, and refrigeration for food, beverage, and industrial needs.

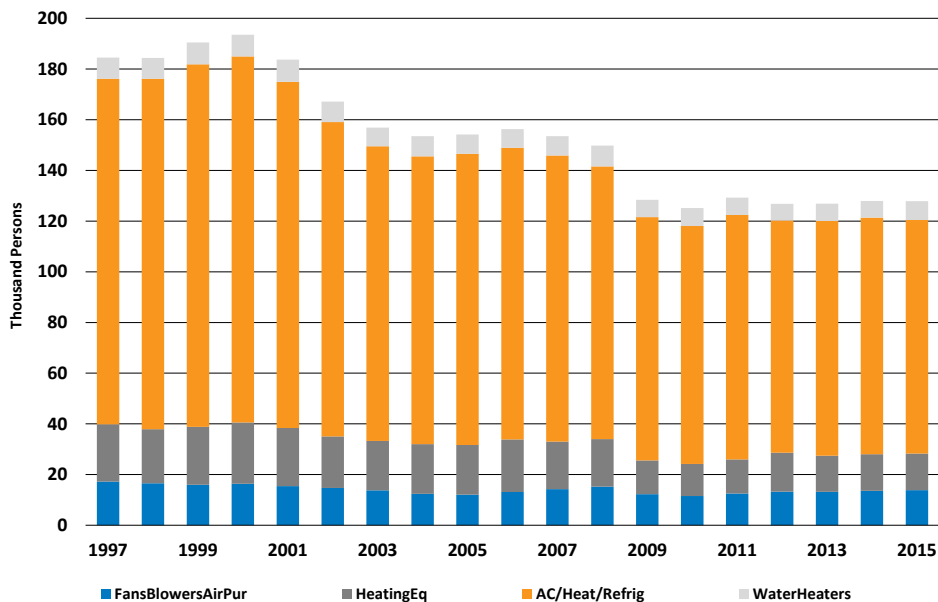
AHRI product scope covers all or part of four industry segments:

- Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing (part) (*FansBlowersAirPur*)
- Heating Equipment, except Warm Air Furnaces, Manufacturing (part) (*HeatingEq*)
- Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing (*AC/Heat/Refrig*)
- Other Major Household Appliance Manufacturing (part) (*WaterHeaters*)

Total product shipments in these four industry segments was about \$42.0 billion in 2015. After declining drastically in 2009 following the economic downturn, growth has brought the total just above peak shipments reached in 2008.

Like most manufacturing industries, these four industry segments have experienced rapid labor productivity growth. This has led to a general decline in employment over the period studied, from a high of nearly 191,000 jobs in 2000 to the current level of 125,400 jobs. Since 1997, employment has declined at an average rate of 2.3 percent per year.

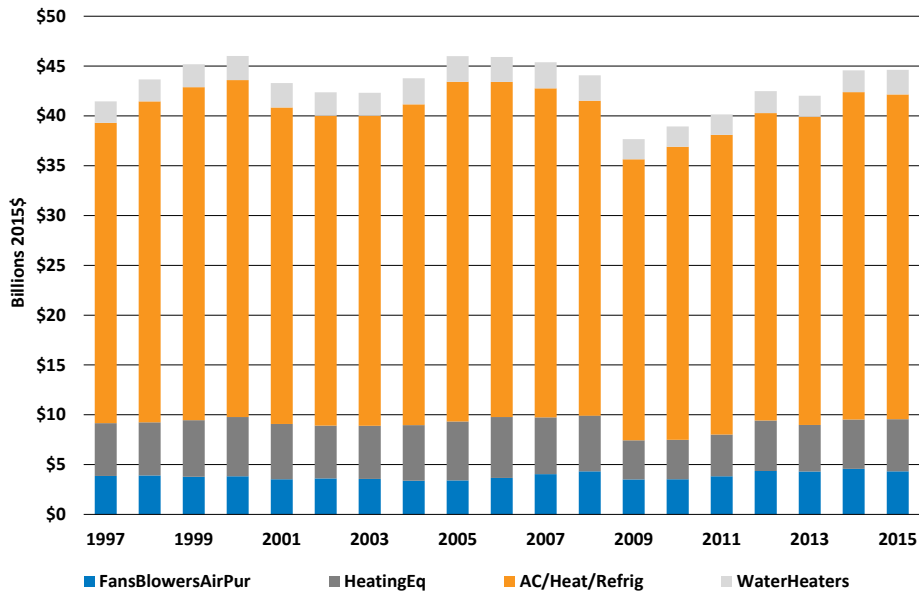
Figure E.1. Total Employment
Units: Thousand persons



Source: Census Bureau, Inforum Iliad Model

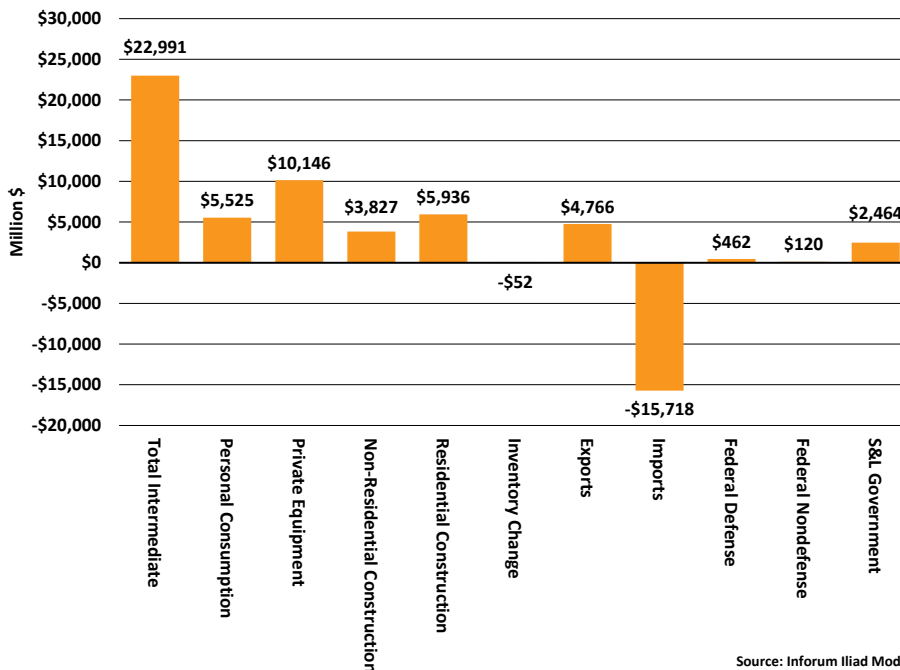
Real output, meanwhile, has expanded by an average of 0.5 percent per year over the same period. HVACR real output reached a peak in 2005, primarily driven by surging real estate markets. Following the downturn, output increased nearly \$7 billion to \$44.6 billion in 2015.

Figure E.2. Real Output
Units: Billions of 2015 Dollars



Source: Census Bureau, Inforum Iliad Model

Figure E.3. Distribution of Output in 2015, AHRI Product Scope
Units: Billions of 2015 Dollars

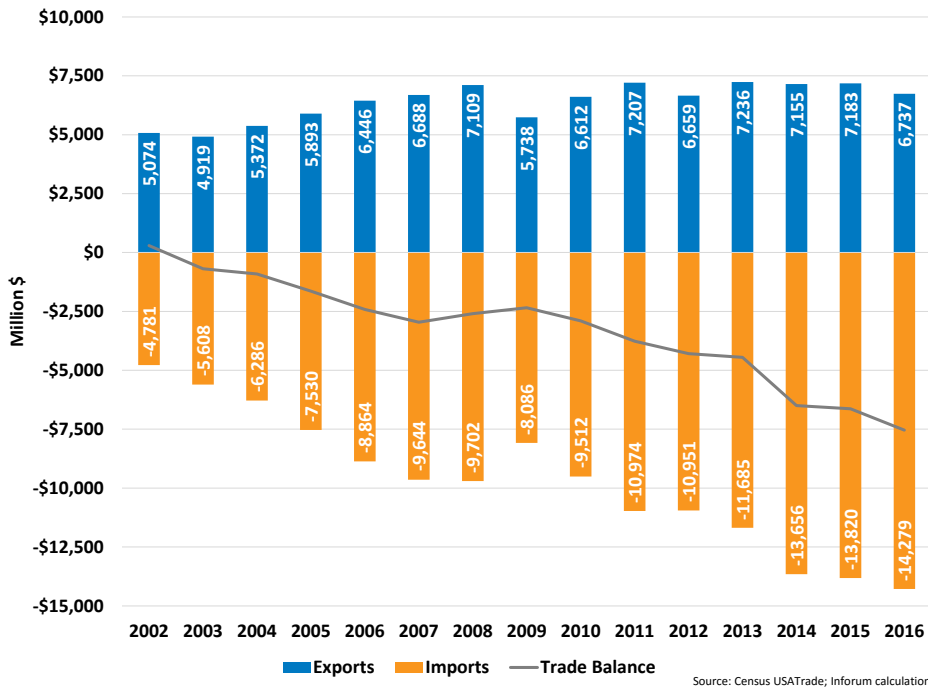


Source: Inforum Iliad Model

Growth in real output can be decomposed into the distribution of output to other industries and to final demand. Approximately 57 percent of total sales are purchased by other industries. These are called intermediate demand. The remaining 43 percent are considered final demand. The largest final demand categories include private equipment investment, residential construction, and personal consumption.

Growth in domestic real output has been slowed by an increase in the trade deficit of HVACR products. Starting from near balance in 2002, the net trade balance is estimated to be about \$7.5 billion in deficit in 2016.

Figure E.4. Exports and Imports, AHRI Product Scope
Units: Millions of Dollars



The impact of the HVACR industry certainly extends beyond the direct economic impacts as measured by the variables described above. In this analysis, the domestic production of the four main industry segments is our starting point, which is called the *direct output*. This activity does not exist in isolation. Instead, it generates demand from supplier industries. These supplier industries in turn generate demand for their supplier industries. All of the output generated beyond the *direct output* is called the *indirect output*. In addition to the direct and indirect impacts, we calculate *induced output*. This represents the additional demand generated by the disposable income earned in the industry (this may be both wage income and capital income).

Associated with the output at each round of impact is the employment required in that sector to produce that output, as well as the value added or income earned. The “upstream” impacts of supplier industries are displayed below in Table E.1. Total jobs within the industry (125,400) plus upstream suppliers (132,100) plus induced jobs (314,300) came to a total of 571,700 in 2015.

Table E.1. Summary of Upstream Analysis
Units Indicated

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Direct	44,622	125.4	15,495	10,133
Indirect	41,591	132.1	19,599	10,339
Induced	62,823	314.3	37,166	17,367
Total	149,035	571.7	72,260	37,839

In addition to these upstream impacts, economic activity is generated in wholesale and retail trade ("downstream") industries that distribute HVACR equipment and related products. These are displayed in Table E.2. Total downstream jobs, including direct, indirect, and induced, came to 311,400 in 2015. The combined impacts are seen in Table E.3, with total upstream and downstream jobs amounting to 883,100. In addition to these jobs, there are approximately 408,000 contractor jobs associated with installation, construction, and maintenance related to HVACR. The total number of jobs, including contractors, amount to 1.29 million.

Table E.2. Summary of Downstream Analysis
Units Indicated

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Direct	21,196	108.1	14,317	6,744
Indirect	11,290	48.6	6,367	3,341
Induced	30,898	154.6	18,277	8,540
Total	63,385	311.4	38,961	18,625

Table E.3. Combined Summary
Units Indicated

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Upstream	149,035	571.7	72,260	37,839
Downstream	63,385	311.4	38,961	18,625
Contractors	44,359	408.0	39,051	22,664
Total	256,779	1,291.1	150,272	79,128

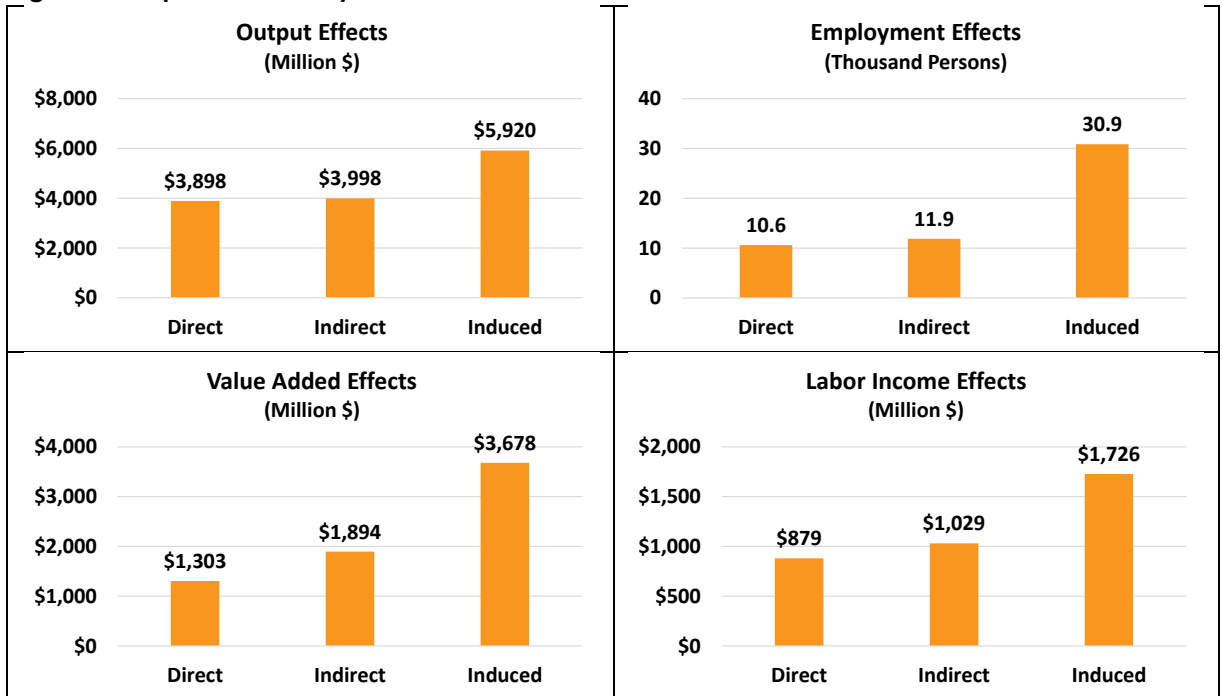
Direct production, supplier production, and induced impacts vary widely by state. In terms of total upstream employment, Texas is the largest, with 53,344 jobs, followed by California with 42,930 jobs.

Table E.4. Top Ten States in Total Upstream Employment
Units: Number of employees

	Direct	Indirect	Induced	Total
Texas	10,596	11,865	30,883	53,344
California	5,543	6,858	30,529	42,930
Tennessee	8,812	10,601	13,420	32,832
Ohio	6,689	7,175	14,929	28,792
Missouri	8,346	7,975	11,524	27,845
Georgia	5,260	5,666	12,117	23,043
Illinois	4,721	4,883	13,176	22,780
Pennsylvania	5,143	4,929	12,415	22,487
New York	2,661	3,027	16,639	22,328
Florida	4,142	4,176	13,331	21,650
Other States	63,441	64,924	145,330	273,695
United States	125,353	132,079	314,293	571,725

Total impacts in Texas are displayed graphically in Figure E.5.

Figure E.5. Upstream Analysis for Texas



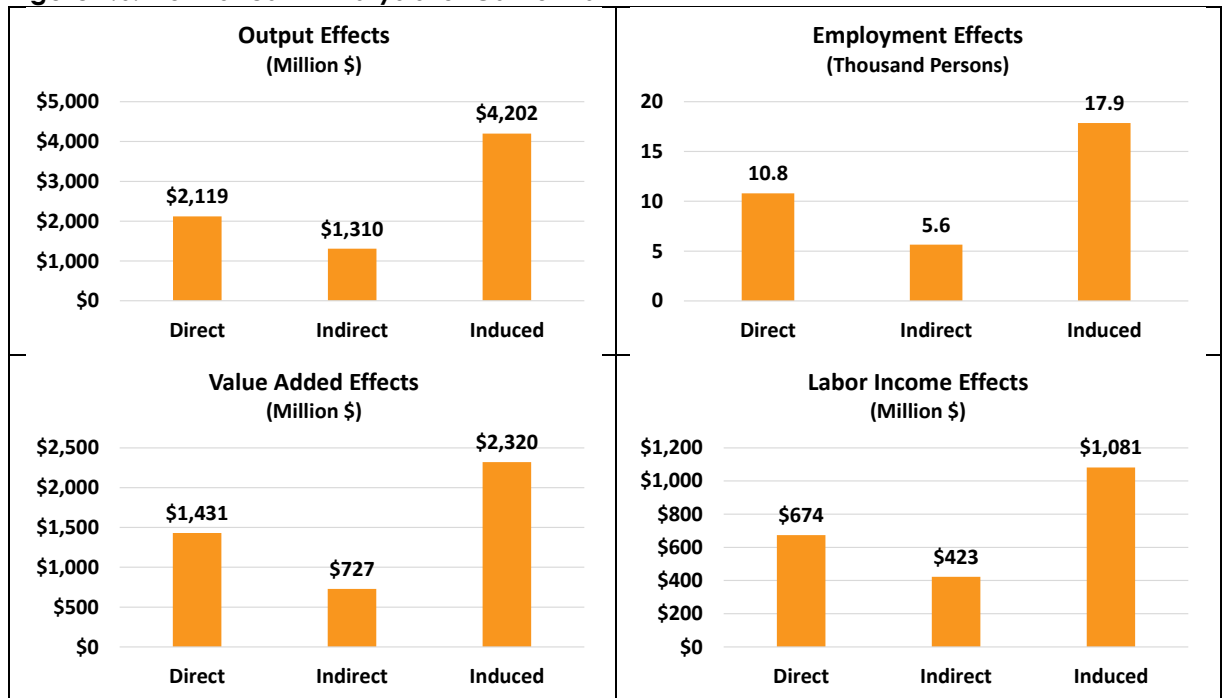
Downstream impacts tend to follow the distribution of overall economic activity, especially construction activity. The largest downstream jobs impact is in California, with 34,307 jobs, followed by Texas, with 29,510 jobs.

Table E.5. Top Ten States in Total Downstream Employment
Units: Number of employees

	Direct	Indirect	Induced	Total
California	10,804	5,641	17,862	34,307
Texas	9,388	4,705	15,417	29,510
Florida	7,467	3,022	10,732	21,221
New York	5,312	2,850	8,194	16,355
Illinois	4,628	2,374	6,827	13,830
Ohio	4,586	2,012	6,485	13,083
Pennsylvania	4,249	1,997	6,008	12,255
Georgia	3,622	1,747	5,716	11,085
North Carolina	3,706	1,581	5,159	10,446
Michigan	3,629	1,473	4,755	9,857
Other States	50,699	21,229	67,486	139,414
United States	108,091	48,630	154,642	311,363

Total downstream impacts in California are displayed in Figure E.6.

Figure E.6. Downstream Analysis for California



1. Introduction

This report presents a current snapshot and summary of the recent economic evolution of the heating, ventilation, air-conditioning, and refrigeration (HVACR) and water heating industry. This report serves as an update and extension of an earlier report published by AHRI in 2012.¹ Like that report, this analysis provides information on the size, scope, and growth of the industry as a whole, along with its contributions to the U.S. economy.

The HVACR manufacturing industry serves many basic requirements of the household, industry, and commercial sectors. These include home and building climate control, supply of hot water, and refrigeration for food, beverage, and industrial needs. The industry segments addressed in this study currently provide direct employment to about 125,000 people in the United States. Together with upstream suppliers, and downstream distributors, the industry accounts for 883,100 U.S. jobs. In addition to these jobs, there are approximately 408,000 contractor jobs associated with installation, construction, and maintenance related to HVACR. The total number of jobs, including contractors, amount to 1.29 million.

Sales from the industry can be viewed as the net result of several components. About 57 percent of total sales are purchased by other industries. These are called intermediate demand, while all other sales are considered final demand. Final demand consists of sales to consumers (14 percent), sales to business for investment (25 percent), sales to residential (14 percent) and nonresidential construction (9 percent), and to government investment (8 percent). Exports also contribute to demand (12 percent), but the share of total demand supplied by imports (39 percent) has been steadily increasing, so net exports are negative.

Total output of the industry in 2015 amounted to \$44.6 billion. Together with the 125,000 jobs mentioned above, the industry generated \$15.5 billion of value added and \$10.1 billion of labor compensation.

Important economic trends and developments impacting this industry are primarily:

- *New residential and non-residential construction* - These final demand components are both highly cyclical, and both were severely depressed by the economic crisis starting in 2009.
- *Exports and Imports* – The outlook for global trade, the value of the dollar, and the existence of trade agreements are very important to this industry. The trade situation is important not only for imports and exports of HVACR equipment, but also because it affects the costs of imported materials and components.
- *Energy costs* – High energy costs can accelerate replacement demand, to replace older equipment with modern, more efficient equipment. Significant changes in the relative natural gas to electricity price can also drive new investment, in cases where either source of energy may be used, such as heating.
- *Regulation and policy* – Government regulations and tax incentives to stimulate energy-efficient equipment can have a positive impact on the HVACR market.

¹ HVACR and Water Heating Industry Statistical Profile, AHRI (2012).

However, onerous regulations and standards can make small producers uncompetitive, as compliance often implies large fixed costs.

The most important macroeconomic risks to the industry continue to be the worsening trade balance in HVACR equipment and the possibility of another construction downturn.

2. Industry Overview

The HVACR manufacturing industries consist of portions of the NAICS² 4-digit industries 3334 and 3352, as shown in Figure 1. In addition to manufacturing, HVACR is closely linked to the wholesale trade industry 4237. Finally, the activity of installation and setup of HVACR is conducted by the construction category 238220³. Although the primary jobs are created in these manufacturing industries, the final delivery of the product to the ultimate consumer is strongly dependent on wholesale (and some retail) trade, and on the installation and setup procedures required in the home or building site.

Figure 1. HVACR Industries – NAICS Codes

- Manufacturing
 - 3334 Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
 - 333413 Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing
 - 333414 Heating Equipment (except Warm Air Furnaces) Manufacturing
 - 333415 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
 - 335228 Other Major Household Appliance Manufacturing
- Wholesale
 - 4237 Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers
- Construction
 - 238220 - Plumbing, Heating, and Air-Conditioning Contractors

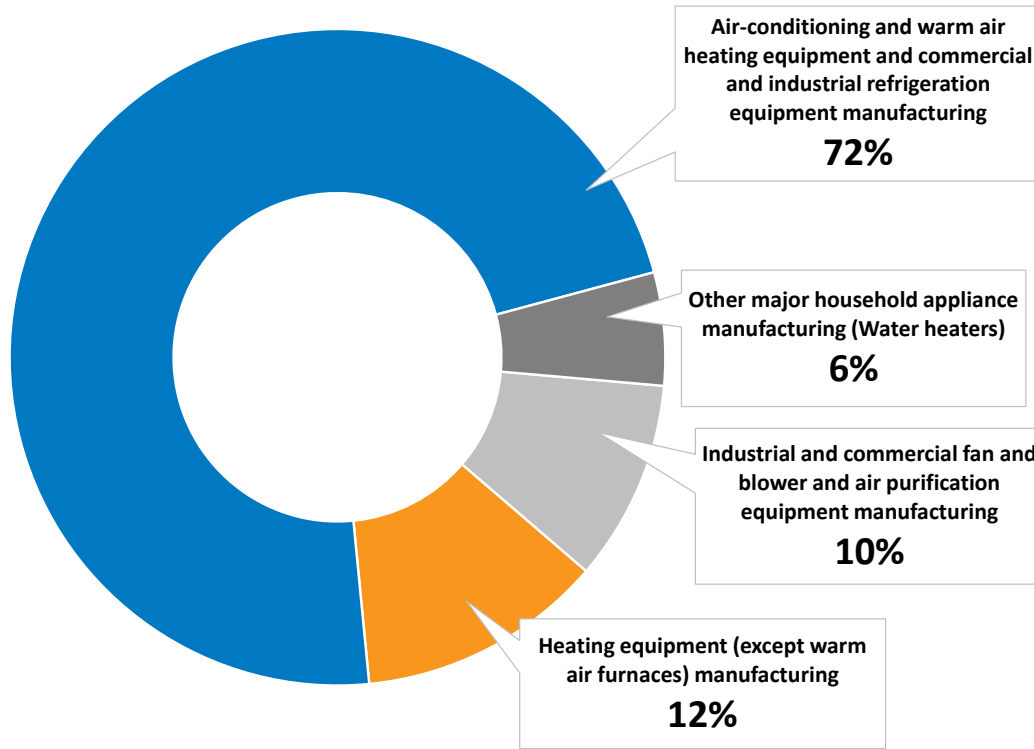
Figure 2 shows the distribution of the manufacturing industry segments, according to the 2012 *Economic Census* (EC2012). Of the total production within the AHRI focus, of \$39.7 billion, by far the largest segment is the air-conditioning and warm air heating equipment and commercial and industrial refrigeration (most of NAICS 333415), at 72 percent or about \$28.7 billion. The next largest, the heating equipment (except warm air furnaces) manufacturing industry (NAICS 333414) comprises 12 percent of the total, at about \$4.8 billion. Industrial and commercial fans and blowers and air purification equipment (part

² NAICS is the North American Industry Classification System. A short explanation is given in the Appendix.

³ We can approach only a rough estimate of the jobs in this sector, as activity related to the installation and maintenance of HVACR equipment is not separately identified.

of NAICS 333413) comes in at 10 percent (\$3.9 billion) and water heaters (part of NAICS 335228) comprises 6 percent, or \$2.2 billion.⁴

Figure 2. Industry Segments



Source: Census Bureau, 2012 Economic Census; Inforum Calculations

Table 1 provides a key to the NAICS codes and descriptions of the industries analyzed in this report, and the percent share that is estimated to be produced by AHRI members. In the tables and graphs that follow, we use the codes in the first column of Table 1 to refer to the industry segments. We will refer to the total of the relevant shares of these industries as the 'AHRI product scope'.

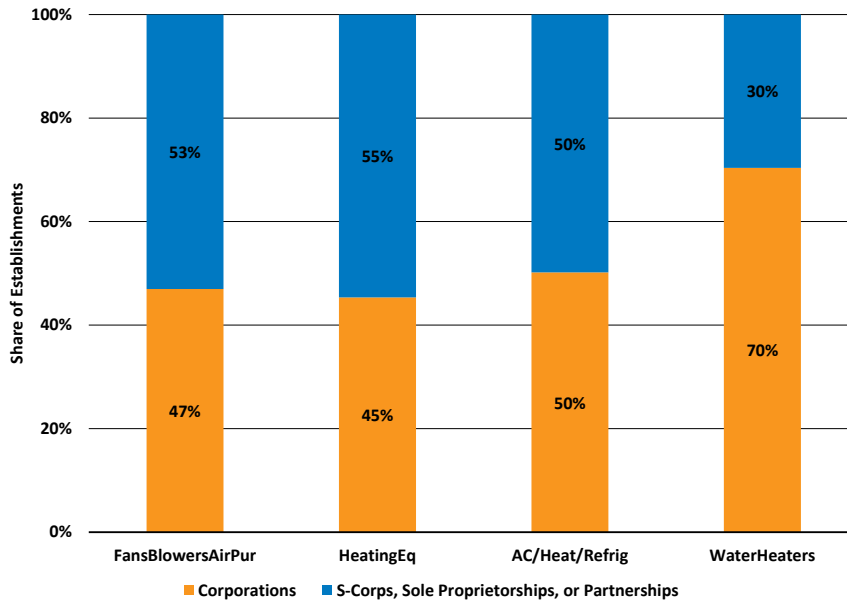
Table 1. Major AHRI Product Segments

Code	NAICS	Description	Share
FansBlowersAirPur	333413	Industrial and commercial fan and blower and air purification equipment	68.9%
HeatingEq	333414	Heating equipment (except warm air furnaces)	100.0%
AC/Heat/Refrig	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration	98.6%
WaterHeaters	335228	Other major household appliances	50.4%

⁴ Table A.3 (in the appendix) shows the detailed categories from the 2012 Economic Census (EC) and the value of product shipments surveyed for 2012. The next EC will be conducted for 2017. The shares of the 4 industries in this report are taken from that table. For example, the share of 335228 is 50.4 percent.

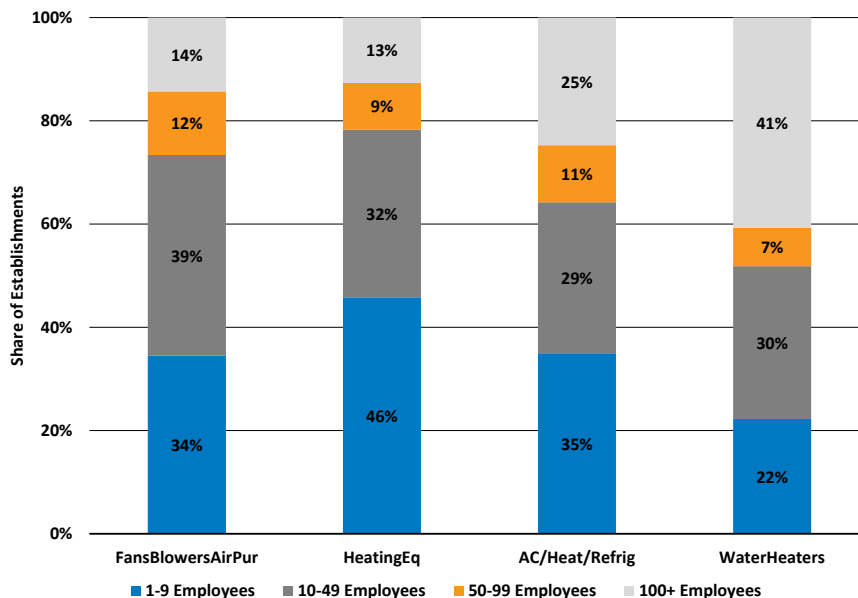
The HVACR manufacturing industries represent a wide variety of companies. Establishments ranging from small businesses to large corporations help to serve the residential, industrial, and commercial sectors. Figure 3 shows the type of business by AHRI product segment in 2015. About half of all FansBlowers, HeatingEq, and AC/Heat/Refrig establishments are corporations. The remainder are S-corporations, sole proprietorships, or partnerships. Meanwhile, approximately 70% of the WaterHeaters segment are corporations. Figure 4 illustrates the size of establishment (number of employees) by AHRI product segment. More than a third of FansBlowers, HeatingEq, and AC/Heat/Refrig establishments have 9 or fewer employees.

Figure 3. Establishment Type by Product Segment



Source: 2015 Census County Business Patterns

Figure 4. Establishment Size (Number of Employees) by Product Segment



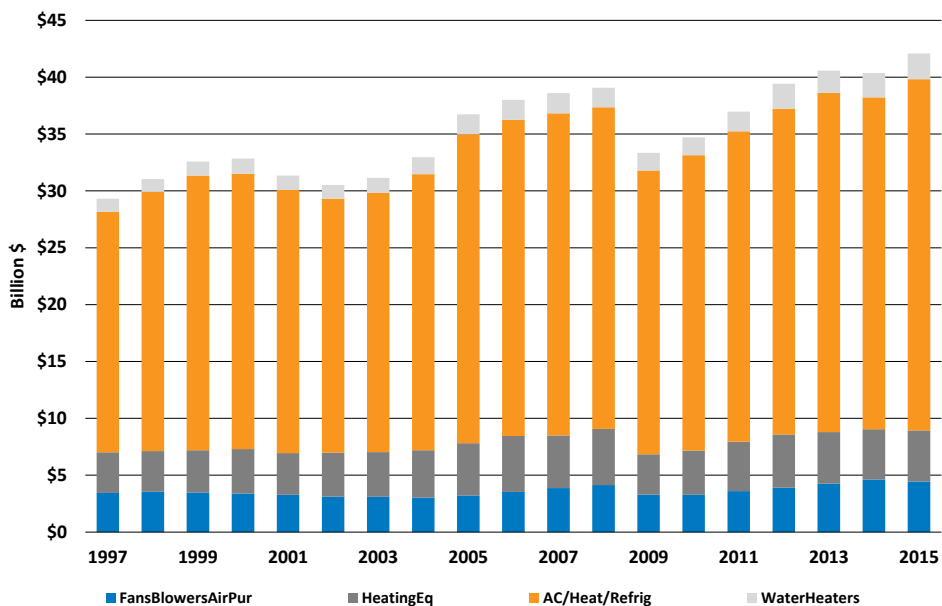
Source: 2015 Census County Business Patterns

Figure 5 shows the path of product shipments of these 4 main segments,⁵ and the total, as measured by the Census Bureau in the Economic Census and Annual Survey of Manufactures, for the period 1997 to 2015. The data are also displayed in Table 2, and growth rates for selected years are in Table 2.

Product shipments are in current prices (i.e., not adjusted for inflation), and are closely related to industry revenue. They are not the same as product output, which is roughly shipments plus inventory change. Product shipments are obtainable from the Census Bureau at a higher level of detail than other data. As a result, they are the best source for discerning sales performance for particular products.

Total product shipments suffered a slowdown after the 2001 recession, declining by 3.7 percent between 2000 and 2002. The industry grew at 4.1 percent from 2002 to 2008, stimulated by rapid economic growth, particularly in the residential and non-residential construction sectors. However, the downturn in 2008-2009 was severe, with the overall industry declining by nearly 16 percent, affecting *FansBlowerAirPur* and *HeatingEq* severely. Growth in the last 6 years has picked up to 3.9 percent overall, but paced by the growth of the largest sector, *AC/Heat/Refrig*. According to the product shipments estimates, the total ARHI product scope had slightly negative growth (-0.5 percent) in 2014 (see Table 3).

Figure 5. Product Shipments



Source: Census Bureau; Inforum Iliad Model

⁵ In this and all subsequent graphs and tables, we are using 2012 EC shares of the 6-digit data as indicated by AHRI.

Table 2. Product Shipments by Industry Segment
Units: Millions of Dollars

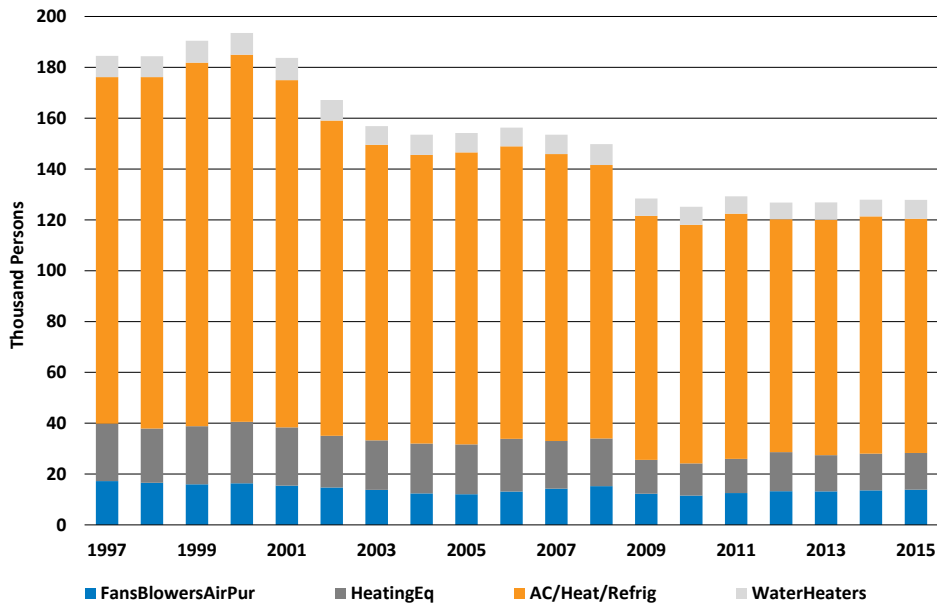
	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total	Total Growth (Percent)
1997	3,441	3,580	21,153	1,133	29,306	
1998	3,541	3,576	22,794	1,133	31,045	5.8
1999	3,482	3,716	24,148	1,238	32,584	4.8
2000	3,397	3,896	24,222	1,338	32,852	0.8
2001	3,276	3,670	23,136	1,273	31,355	-4.7
2002	3,113	3,882	22,309	1,222	30,525	-2.7
2003	3,099	3,927	22,810	1,314	31,150	2.0
2004	3,029	4,161	24,284	1,488	32,961	5.6
2005	3,225	4,587	27,183	1,739	36,735	10.8
2006	3,526	4,925	27,808	1,746	38,005	3.4
2007	3,872	4,624	28,324	1,772	38,592	1.5
2008	4,142	4,926	28,291	1,708	39,067	1.2
2009	3,287	3,546	24,969	1,546	33,348	-15.8
2010	3,282	3,877	25,982	1,575	34,715	4.0
2011	3,603	4,339	27,294	1,735	36,971	6.3
2012	3,907	4,677	28,637	2,208	39,428	6.4
2013	4,263	4,529	29,828	1,959	40,579	2.9
2014	4,628	4,418	29,178	2,152	40,377	-0.5
2015	4,442	4,502	30,877	2,257	42,078	4.1

Table 3. Growth in Product Shipments by Industry Segment
Growth Rates over Selected Intervals

Period	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total
1997-2000	-0.4	2.8	4.5	5.6	3.8
2000-2002	-4.4	-0.2	-4.1	-4.6	-3.7
2002-2008	4.8	4.0	4.0	5.6	4.1
2008-2009	-23.1	-32.9	-12.5	-10.0	-15.8
2009-2015	5.0	4.0	3.5	6.3	3.9
1997-2015	1.4	1.3	2.1	3.8	2.0

Total direct employment in the relevant industry segments is shown in Figure 6. Details by industry segment are shown in Table 4. Growth rates for selected intervals are shown in Table 5.

Figure 6. Total Employment
Units: thousands



Source: Census Bureau, Inforum Iliad Model

Like most manufacturing industries, these four industry segments have experienced rapid labor productivity growth. This has led to a general decline in employment over the period studied, from a high of nearly 191,000 jobs in 2000 to the current level of 125,400 jobs. The fastest declines occurred during and after the two recessions of 2001 and 2009. Since 2010, employment has been flat. In the total period from 1997 to 2015, employment has declined by an average of 2.3 percent per year.

Table 4. Employment by Industry Segment
Units: Number of Jobs

	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total	Total Growth (Percent)
1997	21,090	25,190	128,279	7,676	182,235	
1998	21,056	25,150	128,072	7,711	181,989	-0.1
1999	21,462	26,480	131,601	7,636	187,179	2.8
2000	20,904	27,550	134,599	7,893	190,946	2.0
2001	19,905	26,210	127,007	7,242	180,364	-5.7
2002	19,767	23,950	113,252	7,172	164,141	-9.4
2003	18,520	21,440	107,553	7,147	154,660	-5.9
2004	17,700	22,410	103,234	6,945	150,290	-2.9
2005	17,184	21,710	105,453	6,960	151,307	0.7
2006	18,569	22,800	105,256	6,965	153,589	1.5
2007	19,409	20,640	103,619	6,728	150,396	-2.1
2008	20,725	20,310	98,206	7,237	146,478	-2.6
2009	16,398	16,650	86,827	6,003	125,878	-15.2
2010	15,041	16,650	84,914	6,219	122,825	-2.5
2011	16,295	16,870	87,724	6,260	127,149	3.5
2012	16,818	18,350	83,554	5,630	124,352	-2.2
2013	16,756	17,090	84,688	5,927	124,461	0.1
2014	13,576	14,423	93,376	6,559	127,934	2.8
2015	17,680	15,780	85,417	6,476	125,353	-2.0

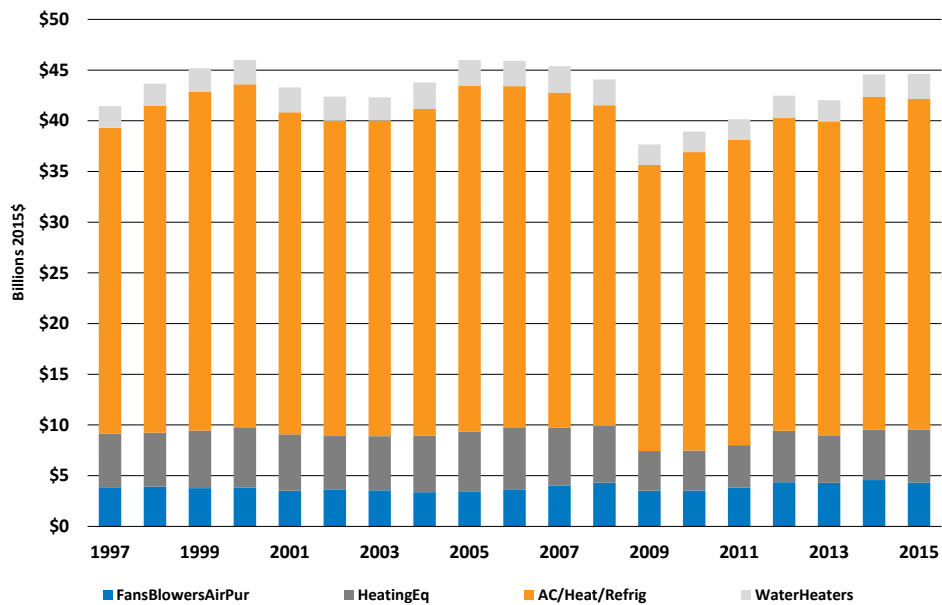
**Table 5. Growth in Employment by Industry Segment
Growth Rates over Selected Intervals**

	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total
1997-2000	-0.3	3.0	1.6	0.9	1.6
2000-2002	0.0	-2.8	-7.0	-8.6	-4.8
2002-2008	0.8	-2.7	-2.4	0.2	-1.9
2008-2009	-23.4	-19.9	-12.3	-18.7	-15.2
2009-2015	1.3	-0.9	-0.3	1.3	-0.1
1997-2015	-1.1	-2.9	-2.5	-1.1	-2.3

We turn next to the behavior of real output, which is derived from data in the Inforum *Iliad* model. This model includes a database of output, prices, employment, value added, and other concepts at a level of 352 producing sectors, which is approximately NAICS 5- to 6-digit detail in most cases. As for the other variables, we show the AHRI share of the four relevant industries in the model.

Figure 7 shows total real output and the values by industry segment. Data underlying this graph are in Table 6, while Table 7 shows growth rates for selected intervals.

Figure 7. Real Output
Units: Billions of 2015 Dollars



Source: Census Bureau, Inforum Iliad Model

Table 6. Real Output by Industry Segment
Units: Millions of 2015 Dollars

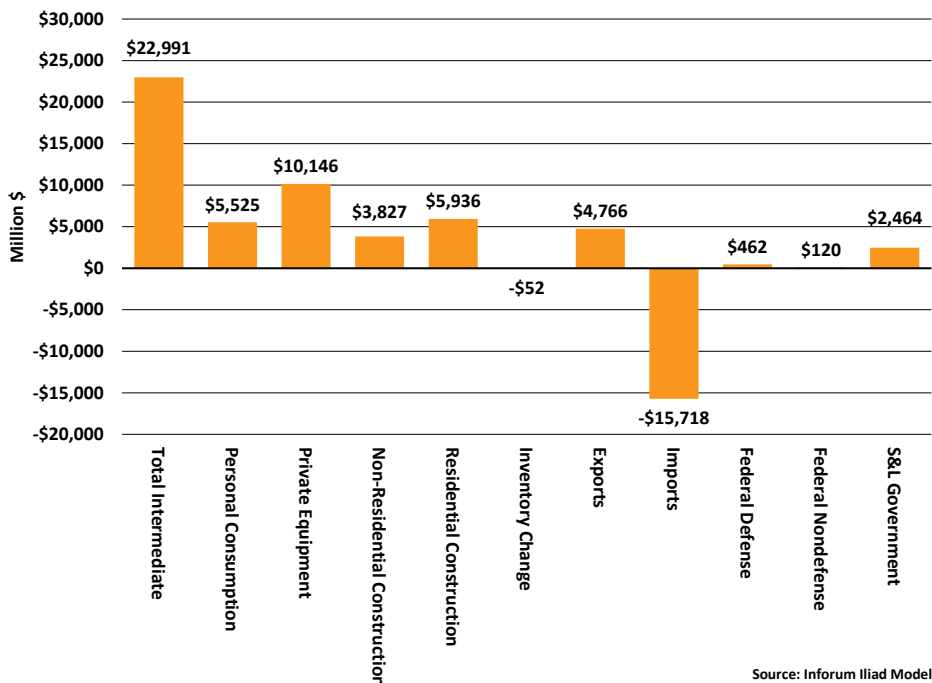
	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total	Total Growth (Percent)
1997	3,852	5,312	30,144	2,144	41,453	
1998	3,917	5,322	32,223	2,207	43,668	5.2
1999	3,776	5,686	33,422	2,296	45,180	3.4
2000	3,828	5,939	33,826	2,421	46,013	1.8
2001	3,527	5,549	31,765	2,454	43,295	-6.1
2002	3,611	5,294	31,107	2,365	42,377	-2.1
2003	3,554	5,334	31,125	2,309	42,323	-0.1
2004	3,375	5,579	32,215	2,606	43,775	3.4
2005	3,409	5,910	34,119	2,552	45,990	4.9
2006	3,657	6,122	33,631	2,502	45,911	-0.2
2007	4,036	5,695	33,042	2,613	45,386	-1.1
2008	4,315	5,590	31,622	2,552	44,079	-2.9
2009	3,515	3,916	28,216	2,020	37,667	-15.7
2010	3,532	3,949	29,425	2,041	38,947	3.3
2011	3,820	4,195	30,090	2,053	40,158	3.1
2012	4,356	5,067	30,855	2,202	42,481	5.6
2013	4,309	4,665	30,945	2,107	42,026	-1.1
2014	4,567	4,960	32,853	2,200	44,580	5.9
2015	4,317	5,236	32,604	2,465	44,622	0.1

Table 7. Growth in Real Output by Industry Segment
Growth Rates over Selected Intervals

	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total
1997-2000	-0.2	3.7	3.8	4.0	3.5
2000-2002	0.0	-2.9	-5.7	-4.2	-1.2
2002-2008	3.0	0.9	0.3	1.3	0.7
2008-2009	-20.5	-35.6	-11.4	-23.4	-15.7
2009-2015	3.4	4.8	2.4	3.3	2.8
1997-2015	0.7	-0.1	0.5	0.9	0.5

Although correlated with the history of product shipments, output will be higher than product shipments when inventories are increasing, and vice-versa. The measure shown here is *real* output, which has been deflated by the industry price. The overall average growth of product shipments (in Table 3) was 2.0 percent. Average real output growth is 0.5 percent. The difference is mostly attributable to the average rate of industry price growth.

Figure 8. Distribution of Output in 2015, AHRI Product Scope
 Units: Millions of 2015 Dollars

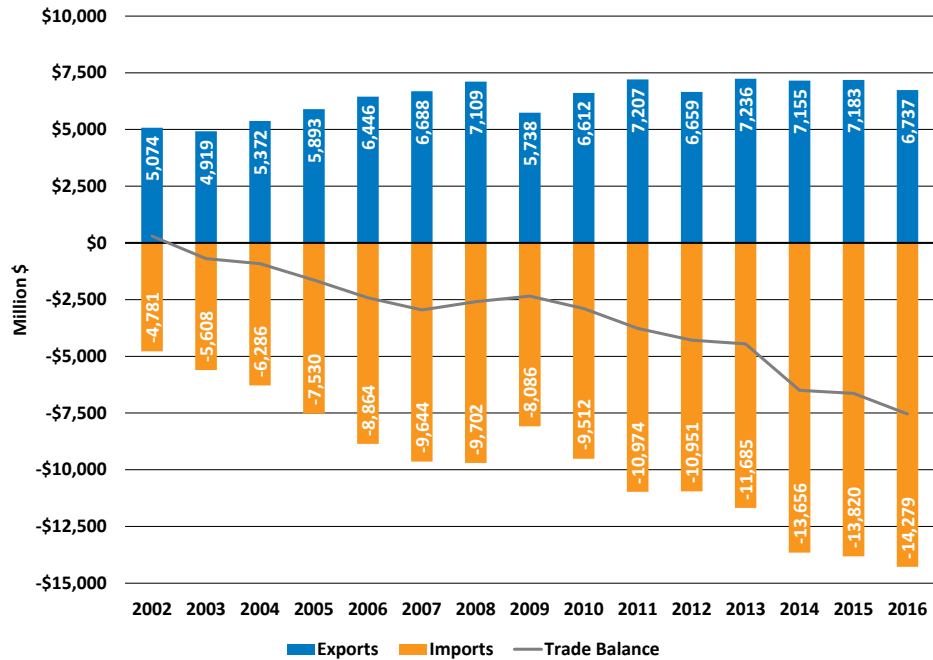


Growth in real output can be decomposed into the distribution of output to other industries and to final demand. Figure 8 shows the distribution on output for the entire sector. Output sold by the industry can be viewed as the net result of several components. About 57 percent of total sales are purchased by other industries. These are called intermediate demand, and all other sales are considered final demand. Final demand consists of sales to consumers (14 percent), sales to business for investment (25 percent), sales to residential (14 percent) and nonresidential construction (9 percent), and to government investment (8 percent). Exports also contribute to demand (12 percent), but the share of total demand supplied by imports (39 percent) has been steadily increasing, so net exports are negative.

Figure 9 juxtaposes total exports and imports of the combined sector. The solid line shows the path of the current price net trade balance for the four industries. Starting from near balance in 2002, the net trade balance is now about 7.5 billion dollars in deficit⁶.

⁶ The main source for Inforum imports and exports data by NAICS is the USA Trade data available from the Census Bureau.

Figure 9. Exports and Imports, AHRI Product Scope
Units: Millions of Dollars



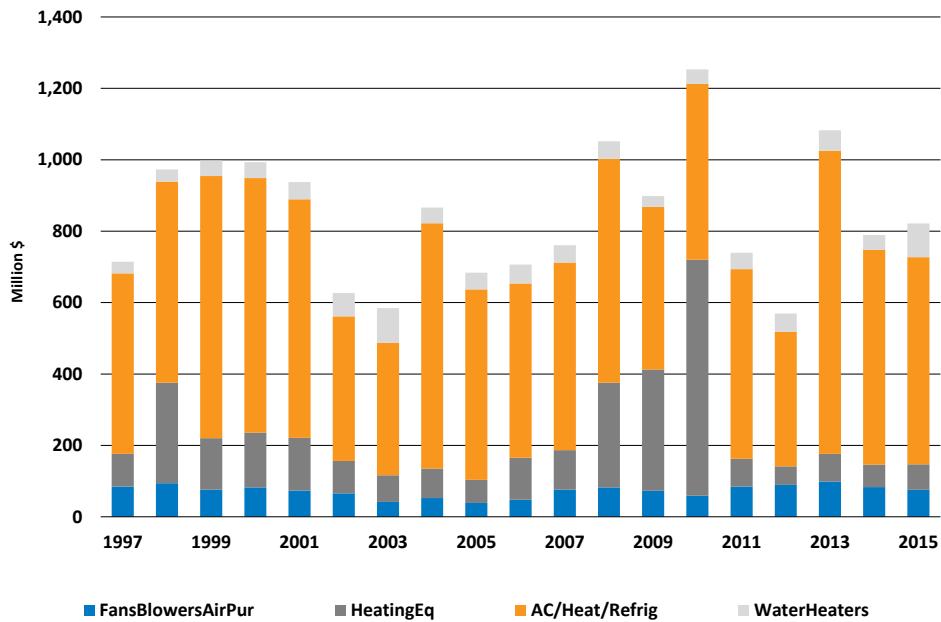
Source: Census USATrade; Inforum calculations

As is the case in most manufacturing industries, capital investment (equipment and buildings) is quite volatile in the HVACR industry segments, as shown in Figure 10. Table 8 presents the same information contained in Figure 10⁷. According to the Census data, investment followed general business activity up to 2008, except for a spike in 2004. However, after the peak in 2008, there was another spike in 2010, despite slack economic activity, driven largely by strong reported investment in *HeatingEq*. Another peak in 2013 was due to increased investment in *AC/Heat/Refrig*. Such peaks often represent construction of new plants, or foreign direct investment by multinationals.

Table 9 summarizes the average growth rates of business investment by industry segment. Growth rates across segments for the total period vary widely, with a high of 6.6 percent in *WaterHeaters*, and an average decline of 1.6 percent in *AC/Heat/Refrig*. Total investment grew at 0.9 percent over the whole 1997 to 2015 period.

⁷ Capital spending by detailed NAICS industry is derived from the *Economic Census* (1997, 2002, 2007 and 2012) and the *Annual Survey of Manufactures, Industry* series.

Figure 10. Capital Investment
Units: Millions of Dollars



Source: Census Economic Census, Annual Survey of Manufacturers

Table 8. Capital Investment by Industry Segment
Units: Millions of Dollars

	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total	Total Growth (Percent)
1997	84,602	91,996	505,154	32,771	714,524	
1998	94,327	281,200	563,216	34,351	973,093	30.9
1999	76,283	144,104	734,153	43,226	997,766	2.5
2000	82,519	153,469	712,958	44,453	993,399	-0.4
2001	73,463	147,670	668,225	48,112	937,471	-5.8
2002	65,698	90,699	405,171	65,008	626,576	-40.3
2003	41,753	74,667	371,234	97,007	584,661	-6.9
2004	52,531	82,785	686,753	44,153	866,223	39.3
2005	38,817	64,758	533,215	47,051	683,841	-23.6
2006	48,035	117,489	487,833	53,216	706,573	3.3
2007	76,254	110,551	525,102	48,863	760,770	7.4
2008	82,411	293,444	626,866	49,102	1,051,823	32.4
2009	72,798	339,833	455,182	30,343	898,157	-15.8
2010	59,215	661,144	492,309	40,280	1,252,948	33.3
2011	84,728	78,139	530,656	45,963	739,486	-52.7
2012	89,520	52,100	376,353	51,647	569,620	-26.1
2013	98,865	77,351	849,009	57,331	1,082,555	64.2
2014	83,527	62,494	601,630	41,272	788,922	-31.6
2015	75,898	71,085	580,295	94,501	821,778	4.1

**Table 9. Growth in Investment by Industry Segment
Growth Rates over Selected Intervals**

	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters	Total
1997-2000	-0.8	17.1	11.5	10.2	11.0
2000-2002	0.0	-11.4	-26.3	-28.3	19.0
2002-2008	3.8	19.6	7.3	-4.7	8.6
2008-2009	-12.4	14.7	-32.0	-48.1	-15.8
2009-2015	0.7	-26.1	4.0	18.9	-1.5
1997-2015	-0.7	-1.6	0.9	6.6	0.9

Table 10 summarizes the growth in output prices of the 4 main 6-digit NAICS industries.⁸ Overall price growth for the period of study averaged between 2.0 and 2.5 percent. Price growth was fastest in the 2002 to 2008 period, when there was upward pressure on commodities and materials prices that affected prices of many manufacturing industries. Prices of *AC/Heat/Refrig* and *WaterHeaters* both grew strongly in the 2008-2009 recession, but most sectors had reduced price inflation during this period, as in the period of 2000-2002.

**Table 10. Growth in Output Prices by Industry Segment
Growth Rates over Selected Intervals**

	FansBlowersAirPur	HeatingEq	AC/Heat/Refrig	WaterHeaters
1997-2000	1.2	0.9	0.6	-0.3
2000-2002	0.0	0.9	0.7	0.1
2002-2008	3.5	3.6	3.3	3.6
2008-2009	0.0	3.9	0.8	6.4
2009-2015	1.4	1.6	1.6	1.2
1997-2015	2.2	2.5	2.0	2.0

⁸ These output prices are derived by Inforum for the *Iliad* model from BEA gross output deflators.

3. National Economic Impact Analysis

The impact of the HVACR industry certainly extends beyond the direct economic impacts as measured by the variables presented in the industry overview in the previous section. Jobs are also supported in supplier ("upstream") industries that provide components, materials, energy, and various services to the HVACR industry, as well as the transportation and trade industries that distribute these inputs. In addition to these upstream impacts, jobs are supported in wholesale and retail trade ("downstream") industries that distribute HVACR equipment and related products. Finally, construction contractors in the heating and air-conditioning installation and maintenance sector rely on the HVACR industry.

3.1 Upstream Analysis

Table 11 shows an example of information that can be extracted from the input-output (IO) framework of the Inforum *Iliad* model. This table shows the top 25 elements in the column of the IO table for the industry which is NAICS 333415, "Air-conditioning, refrigeration, and warm air heating equipment" (code AC/Heat/Refrig). A column of the IO table shows the suppliers to the industry. Another way to think of it is the combination of inputs purchased to produce that industry's products.

The first two columns of Table 11 show the NAICS code(s) and title of each supplying industry. The third column shows the value of purchases from that industry by industry 333415 in 2015. No doubt, someone with a detailed knowledge of the production and operation of establishments in this industry would be able to easily identify specific products and services represented in this table. Total output of each industry is the sum of all purchases from other industries, plus value added. Value added in turn can be divided into labor compensation, gross operating surplus (profits, depreciation, interest, rent, etc.), and indirect taxes.

As is often the case, the largest amount of purchases come from other establishments within the industry, which in this industry is \$4.7 billion out of total output of \$33 billion. The second largest purchase is from Wholesale trade (\$3.3 billion), which represents the wholesale trade margins (markups) paid on products supplied to this industry. Copper bars, plates, sheets, strips, tubes, and wires comes in third, at \$1.7 billion. As we continue down the list, we find many other manufacturing industries which supply to this industry. The manufacturing sector in the U.S. and other advanced economies is highly integrated, with a large portion of components purchased from other manufacturing industries.

However, three of the industries in this top 25 list are services. The largest, at \$792 million (#6 in the list), represents company headquarters and auxiliaries that provide services to the industry. This may include indirect purchases of advertising services, engineering services, research and development, and architectural and design services, among others. Lessors of nonfinancial assets provides \$197 million in services, which represent licensing of patents, trademarks, brand names, and other intangibles. Finally, there are purchases of \$164 million from securities and commodities brokers, who provide services underwriting securities issues, or acting as agents or brokers.

Each of the industries listed in Table 11 also provides employment, generates value added, and requires supplies from other industries. Keep in mind that for most supplier

industries, some share is imported. This imported portion does not contribute to the generation of U.S. income, jobs, and production.

Table 11. Top 25 Upstream Suppliers to AC/Heat/Refrig (NAICS 333415) in 2015
Millions of Dollars

NAICS	Title	2015 Value
333415	Air conditioning, refrigeration, and warm air heating equipment	4655.8
42	Wholesale trade	3327.0
33142	Copper rolling, drawing, extruding and alloying	1660.4
335312	Motors and generators	1295.1
3311,3312	Primary ferrous metal products	1283.8
55	Management of companies and enterprises	792.2
331315, 331316, 331319	Aluminum product manufacturing from purchased aluminum	617.0
334512	Automatic environmental controls	469.0
33291-3,332919	Metal valves	413.4
484	Truck transportation	361.4
335314	Relays and industrial controls	342.1
333414	Heating equipment (except warm air furnaces)	337.6
33211	Forging and stamping	298.8
33272	Turned products and screws, nuts and bolts	292.0
33151	Ferrous metal foundries	291.5
333411-2	Air purification and ventilation equipment	281.3
334511	Search, detection, and navigation instruments	275.8
331411	Primary smelting and refining of copper	251.4
32221	Paperboard containers	222.8
325211	Plastics materials and resins	220.1
327992,3,9	Other non-metallic mineral products	199.1
533	Lessors of nonfinancial intangible assets	197.4
32619	Other plastics products	192.3
334411,2,4-7,9	Other electronic components	184.9
5231-2	Securities and commodity contracts intermediation and brokerage	163.9
Total Commodity Output		33067.4

In this analysis, the domestic production of the four main industry segments is our starting point, which is called the *direct output*. From this, we derive the inputs of the supplier industries, stripping off an estimated share of imports, and allocating a certain amount to value added (labor, capital and indirect taxes). These supplier industries in turn generate demand for their supplier industries. The process continues back to each stage of supplier, with imports and value added stripped off in each step. At some point, the additional calculated supplier input becomes vanishingly small. All of the output generated beyond the *direct output* is called the *indirect output*.

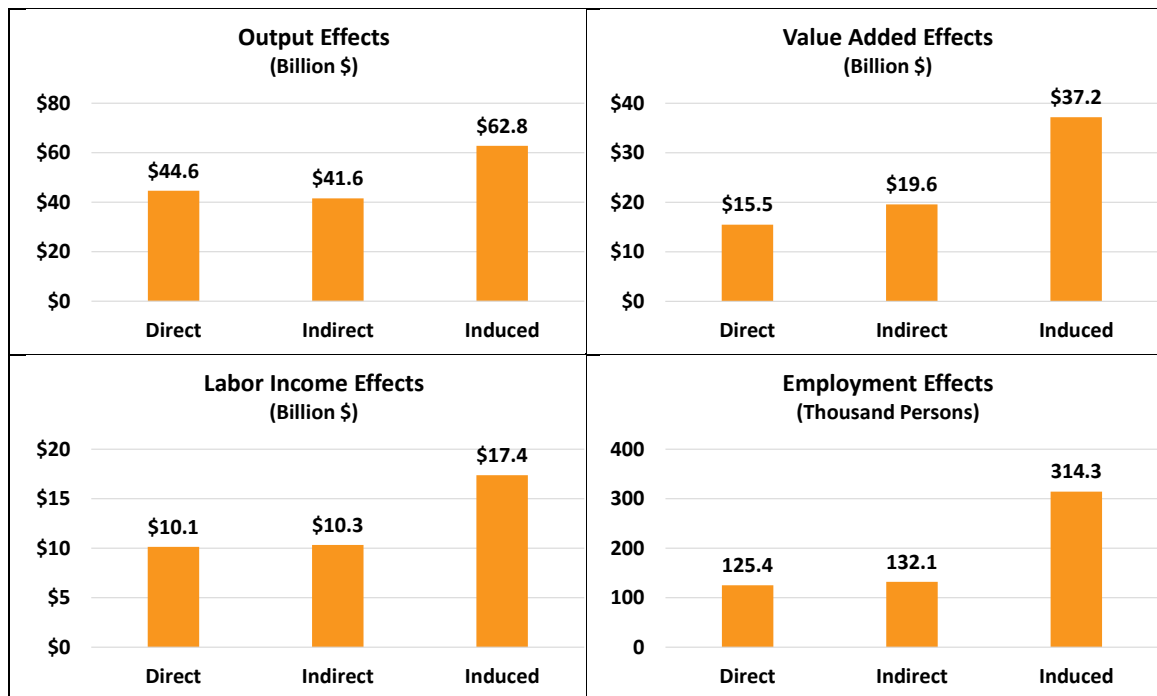
Associated with direct output is the employment required in that sector to produce that output, as well as the value added or income earned. Part of this value added is labor income. The *indirect output* also generates employment, value added, and labor income. Table 12 and Figure 11 show the results of the upstream analyses, providing a summary of total direct and indirect output, employment, value added, and labor income.

Table 12. Summary of Upstream Analysis
Units Indicated

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Direct	44,622	125.4	15,495	10,133
Indirect	41,591	132.1	19,599	10,339
Induced	62,823	314.3	37,166	17,367
Total	149,035	571.7	72,260	37,839

The direct output, which is the starting point, was derived by taking the AHRI-specified shares of the 4 NAICS industries 333413 (*FansBlowersAirPur*), 333414 (*HeatingEq*), 333415 (*AC/Heat/Refrig*) and 335228 (*WaterHeaters*). In 2015, this is estimated to be approximately \$44.6 billion dollars. Direct employment in these industry segments amounted to 125,400. Value added generated was about \$15.5 billion, and of this, about \$10.1 billion was labor income. This is all shown in the first line of Table 12. From the second line, we can see that indirect output amounted to an additional \$41.6 billion, generating 132,100 jobs, \$19.6 billion in value added, and \$10.3 billion in labor income.

Figure 11. Upstream Analysis
Units: Billions of Dollars



In addition to the direct and indirect impacts, we calculate an *induced output*. This represents the additional demand generated by the disposable income earned in the industry (this may be both wage income and capital income). We estimate the mix of consumer goods and services purchased by this income, and calculate the output, employment, value added, and labor income associated with this induced output. This is shown in the third row of Table 12. The total impacts are summarized in the fourth row. For example, the total upstream direct, indirect, and induced employment comes to 571,700 jobs.

Note that Table 12 shows only a summary of results, which are calculated for 352 goods and services in the *Iliad* model. Each industry has its particular employment to output ratio, value added to output ratio, and labor income to output ratio. For example, a dollar of output generated in the retail trade industry creates more jobs than a dollar in the tobacco manufacturing industry. The latter industry, on the other hand, generates more capital income per dollar of output. The individual footprint of any given industry is a result of several factors:

- The distribution of purchases from supplier industries, and the purchases from their suppliers, etc.
- The labor/output, value added/output, and labor income/output ratios in each industry.
- The import share of each industry.

3.2 Downstream Analysis

In addition to jobs, value added, and output in the supplier industries, some portion of economic activity in the wholesale and retail trade industries is due to sales of products from the four HVACR industry segments. This impact, which is often termed the "downstream" impact, also has *direct*, *indirect*, and *induced* components.

The IO framework includes estimates of *margins* on each transaction. These may be wholesale and retail markups, the cost necessary to bring the product to its final users. Looking across the row of the IO table shows the distribution of buyers of each product. Table 13 shows the largest elements of that distribution for NAICS industry 333415 (*AC/Heat/Refrig*).

Table 13. Summary of AC/Heat/Refrig (333415) Sales to Other Sectors

Sales from 333415 to...	% of Intermediate Sales
Air conditioning, refrigeration, and warm air heating equipment	22.5%
Nonresidential maintenance and repair	10.2%
State and local general government	5.5%
Residential maintenance and repair	5.3%
Automobiles	5.3%
Junior colleges, colleges, universities, and professional schools	3.2%
Fruit and vegetable canning, pickling, and drying	2.9%
Services to buildings and dwellings	2.3%
Full-service restaurants	2.3%
Heavy duty trucks	2.1%
Hospitals	2.1%
Pipeline transportation	2.1%
Waste management and remediation services	2.0%
Plastic foam products	1.9%
All other sectors	30.3%

Most of these purchasing industries buy the equipment through wholesale dealers, some through retail. Most final households buy products from this industry through retail trade. For the downstream analysis, we calculated intermediate and final sales by each of the four main HVACR industry segments. Next, we calculated the wholesale and retail

margins associated with these sales. The total margins were taken as *direct output* for the downstream analysis.

Table 14 and Figure 12 show a summary of the direct, indirect, and induced impacts arising from downstream sales. The first row of the table shows direct output, at \$23.0 billion. This is the total wholesale and retail margins associated with sales from the four HVACR industries. Wholesale and retail trade employment due to this activity is 108,100. Direct value added and labor income are \$14.3 billion and \$6.7 billion, respectively.

As in the upstream supplier analysis, downstream impacts also lead to indirect and induced output, and their associated employment, value added, and labor income. These are shown in the second and third rows of Table 14, with the total of direct, indirect, and induced at the bottom.

Table 14. Summary of Downstream Analysis
Units Indicated

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Direct	21,196	108.1	14,317	6,744
Indirect	11,290	48.6	6,367	3,341
Induced	30,898	154.6	18,277	8,540
Total	63,385	311.4	38,961	18,625

Figure 12. Downstream Analysis
Units: Billions of Dollars

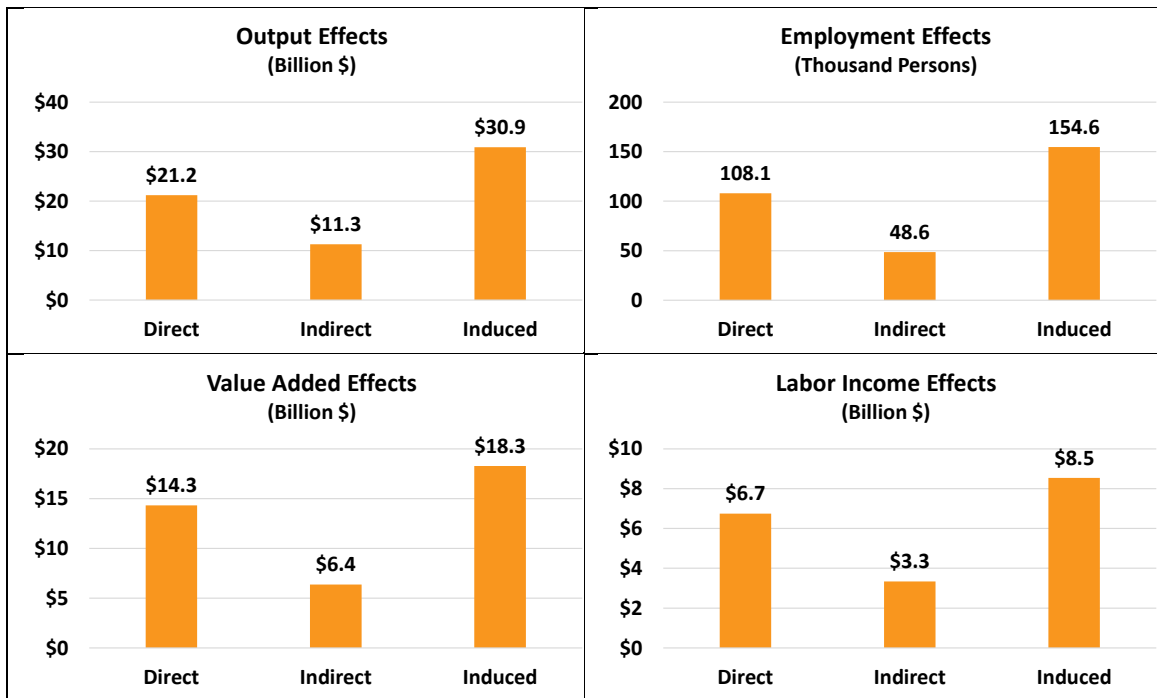


Table 15 shows the combined results from the upstream and downstream analysis. Total national jobs from upstream and downstream output amount to 883,100.

**Table 15. Combined Summary
Units Indicated**

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Upstream	149,035	571.7	72,260	37,839
Downstream	63,385	311.4	38,961	18,625
Contractors	44,359	408.0	39,051	22,664
Total	256,779	1,291.1	150,272	79,128

Additional activity in the construction industry is estimated in the BLS Current Population Survey (CPS) to employ about 408,000 people⁹. Including contractors brings total employment up to 1.29 million.

4. State-Level Economic Impact Analysis

The national level economic impacts described in section 3 can be seen as the sum of economic impacts at the state level. National level *direct* production, employment, value added, and earnings have been distributed to the state level using employment shares taken from the BLS *Census of Employment and Wages* (CEW), for both the upstream and the downstream analysis.

In order to calculate the indirect and induced impacts of production, we use the Regional Input-Output Modeling System (RIMS II) multipliers purchased from the Bureau of Economic Analysis.¹⁰ RIMS II is often used by investors, planners and elected officials to assess potential local economic impacts of various projects. The RIMS multipliers can be used to determine within-state indirect impacts (Type I) and induced impacts (Type II). Out-of-state impacts have been estimated and distributed by Inforum, as described in the Appendix. We have used RIMS to calculate direct, indirect and induced upstream impacts for output, employment (jobs), labor income and total value added. These impacts have been calculated for each of the four industry segments comprising the AHRI product scope.

Table 16 shows summary impacts of the upstream for all 50 states and DC. This table is the sum of 4 tables prepared for the industry segments, which can be found in the appendix tables A.5 to A.8. For all industry segments together, the state with the largest impacts is Texas, with \$3,898 million of direct output, and 10,596 jobs, which represent 8.45 percent of the national total. The second largest state is Tennessee, with 7.03 percent, and \$3,272 million in direct output, and 8,812 jobs.

⁹ This estimate, for the occupation "Heating, air conditioning, and refrigeration mechanics and installers", was taken from the table found at <https://www.bls.gov/cps/aa2015/cpsaat11b.htm>.

¹⁰ See BEA (2012) and BEA (1997) for more detailed descriptions of RIMS II. Appendix A contains a more detailed description of how the results were derived.

Table 16. Summary of State-Level Upstream Analysis

State	Direct State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		44,622	41,589	62,818	149,029	125,353	132,079	314,293	571,725	15,495	19,598	37,163	72,257	10,133	10,338	17,366	37,837
1 Alabama	1.61%	676	604	707	1,987	2,014	2,558	4,150	8,723	249	264	441	954	154	139	210	503
2 Alaska	0.00%	-	54	211	265	-	85	635	720	-	29	95	124	-	25	43	67
3 Arizona	0.71%	324	377	1,017	1,718	894	1,137	3,952	5,983	110	196	517	823	74	128	238	440
4 Arkansas	2.43%	1,120	771	432	2,323	3,043	3,375	3,845	10,263	368	324	355	1,048	251	109	174	534
5 California	4.42%	1,965	2,994	8,532	13,492	5,543	6,858	30,529	42,930	701	1,565	4,217	6,484	450	1,098	1,936	3,484
6 Colorado	0.86%	379	433	1,107	1,920	1,077	1,152	4,472	6,701	130	225	576	930	86	145	266	496
7 Connecticut	0.67%	288	336	889	1,513	834	725	3,095	4,655	108	170	436	713	68	113	199	380
8 Delaware	0.11%	53	73	237	363	139	90	770	999	17	38	111	166	12	24	50	86
9 Dist. of Columbia	0.00%	-	108	422	531	-	170	1,269	1,439	-	59	189	248	-	49	86	135
10 Florida	3.30%	1,444	1,256	3,025	5,724	4,142	4,176	13,331	21,650	505	646	1,631	2,782	330	394	756	1,480
11 Georgia	4.20%	1,953	1,622	1,723	5,298	5,260	5,666	12,117	23,043	640	754	1,238	2,631	437	349	585	1,371
12 Hawaii	0.00%	-	71	278	349	-	112	835	947	-	39	124	163	-	32	56	89
13 Idaho	0.10%	45	70	229	344	127	195	769	1,092	17	37	107	161	10	27	49	87
14 Illinois	3.77%	1,598	1,815	2,709	6,122	4,721	4,883	13,176	22,780	587	854	1,634	3,076	370	486	762	1,617
15 Indiana	3.55%	1,542	1,330	1,185	4,058	4,449	4,376	7,890	16,715	544	577	837	1,958	352	265	400	1,016
16 Iowa	1.87%	864	668	619	2,151	2,349	2,710	3,903	8,962	288	293	406	987	192	119	193	505
17 Kansas	2.07%	944	626	538	2,108	2,594	2,603	3,696	8,893	322	291	388	1,001	211	102	180	493
18 Kentucky	2.46%	1,020	822	681	2,523	3,089	2,852	4,739	10,681	377	346	485	1,208	237	150	230	617
19 Louisiana	0.60%	287	331	881	1,499	755	969	3,270	4,994	93	170	434	697	64	108	201	372
20 Maine	0.13%	60	67	201	328	161	202	730	1,094	20	35	98	153	13	23	45	82
21 Maryland	1.08%	502	478	1,268	2,249	1,357	938	4,675	6,970	167	248	640	1,056	113	143	292	548
22 Massachusetts	1.04%	452	626	1,654	2,732	1,308	1,185	5,892	8,385	169	323	817	1,308	103	213	373	689
23 Michigan	3.10%	1,392	1,325	1,630	4,347	3,892	4,514	9,154	17,559	481	612	1,014	2,107	317	323	484	1,124
24 Minnesota	2.55%	1,149	975	1,156	3,280	3,201	3,321	6,884	13,407	404	472	777	1,652	258	232	366	856
25 Mississippi	2.45%	1,158	674	380	2,213	3,067	3,085	3,657	9,809	378	275	322	975	260	76	158	494
26 Missouri	6.66%	3,041	2,149	1,040	6,230	8,346	7,975	11,524	27,845	1,012	954	1,075	3,041	683	299	506	1,488
27 Montana	0.00%	1	41	161	204	4	61	484	549	1	22	72	95	0	18	33	51
28 Nebraska	0.16%	61	129	404	594	201	358	1,361	1,920	25	67	190	282	14	50	87	151
29 Nevada	0.12%	38	133	485	657	149	296	1,553	1,998	17	71	224	311	9	57	102	168
30 New Hampshire	0.59%	272	180	258	710	741	571	1,251	2,563	95	88	152	335	61	37	70	168
31 New Jersey	1.61%	720	863	1,973	3,556	2,016	1,795	7,514	11,325	251	434	1,023	1,708	163	257	467	887
32 New Mexico	0.03%	15	88	344	447	40	98	1,032	1,171	5	43	154	202	3	36	70	110
33 New York	2.12%	906	1,639	5,017	7,562	2,661	3,027	16,639	22,328	336	854	2,390	3,581	208	612	1,085	1,905
34 North Carolina	3.95%	1,625	1,434	1,724	4,782	4,951	5,325	10,510	20,785	607	646	1,137	2,390	380	345	537	1,262
35 North Dakota	0.04%	16	59	215	290	47	103	670	820	6	32	98	136	3	25	45	73
36 Ohio	5.34%	2,375	2,351	2,154	6,880	6,689	7,175	14,929	28,792	836	1,047	1,535	3,418	542	519	736	1,797
37 Oklahoma	4.48%	2,056	1,237	714	4,007	5,612	5,475	7,546	18,633	684	540	674	1,898	462	194	336	991
38 Oregon	0.37%	151	241	739	1,131	468	552	2,541	3,561	58	125	353	535	35	90	161	287
39 Pennsylvania	4.10%	1,838	1,826	2,491	6,154	5,143	4,929	12,415	22,487	647	845	1,496	2,988	420	445	698	1,564
40 Rhode Island	0.00%	-	50	195	246	-	79	587	666	-	27	88	115	-	23	40	62
41 South Carolina	1.97%	877	737	694	2,308	2,464	2,816	4,875	10,155	312	324	492	1,129	200	154	233	587
42 South Dakota	0.07%	31	52	165	248	86	141	555	782	11	27	78	116	7	20	36	62
43 Tennessee	7.03%	3,272	2,474	1,096	6,843	8,812	10,601	13,420	32,832	1,096	1,097	1,254	3,447	734	402	609	1,746
44 Texas	8.45%	3,898	3,998	5,920	13,815	10,596	11,865	30,883	53,344	1,303	1,894	3,678	6,874	879	1,029	1,726	3,635
45 Utah	0.53%	225	239	510	973	667	894	2,269	3,830	85	121	276	482	50	77	128	256
46 Vermont	0.23%	95	58	106	260	288	265	508	1,062	37	29	60	125	21	15	28	63
47 Virginia	2.62%	1,216	941	1,671	3,828	3,290	2,746	7,579	13,616	405	458	941	1,804	275	222	431	929
48 Washington	1.28%	565	586	1,539	2,689	1,605	1,761	5,818	9,184	205	305	781	1,291	126	199	359	684
49 West Virginia	0.00%	-	69	269	338	-	108	808	916	-	37	120	158	-	31	55	86
50 Wisconsin	5.15%	2,112	1,470	1,070	4,652	6,459	5,065	9,125	20,649	785	648	866	2,299	494	290	427	1,212
51 Wyoming	0.00%	-	39	152	191	-	61	458	519	-	21	68	89	-	18	31	49

Table 17. Top Ten States in Total Upstream Employment

	Direct	Indirect	Induced	Total
Texas	10,596	11,865	30,883	53,344
California	5,543	6,858	30,529	42,930
Tennessee	8,812	10,601	13,420	32,832
Ohio	6,689	7,175	14,929	28,792
Missouri	8,346	7,975	11,524	27,845
Georgia	5,260	5,666	12,117	23,043
Illinois	4,721	4,883	13,176	22,780
Pennsylvania	5,143	4,929	12,415	22,487
New York	2,661	3,027	16,639	22,328
Florida	4,142	4,176	13,331	21,650
Other States	63,441	64,924	145,330	273,695
United States	125,353	132,079	314,293	571,725

Table 17 provides a perspective on which states rank the highest in terms of total upstream impacts. Texas and California are no surprise, as both states have large and diversified economies. Tennessee, however is surprising, as it is only ranked number 18 in state GDP. Other top states are concentrated in the Midwest. Note how the ranking differs according to whether or not indirect and induced impacts are included. New York, which has smaller direct production than Florida, experiences a larger impact in total, especially due to the large induced impact.

Table 18. Total Upstream Impacts in Texas

	Output (Million \$)	Employment	Value Added (Million \$)	Labor Income (Million \$)
Direct	3,898	10,596	1303	879
Indirect	3,998	11,865	1894	1,029
Induced	5,920	30,883	3678	1,726
Total	13,815	53,344	6874	3,635

Table 18 is a state summary of all impacts for Texas, with 53,344 has the largest total jobs impact. Like several states with diversified economies, much of the impact serves induced demand, much of it from other states. Figure 13 shows the same figures in graphical form.

Figure 13. Upstream Analysis for Texas

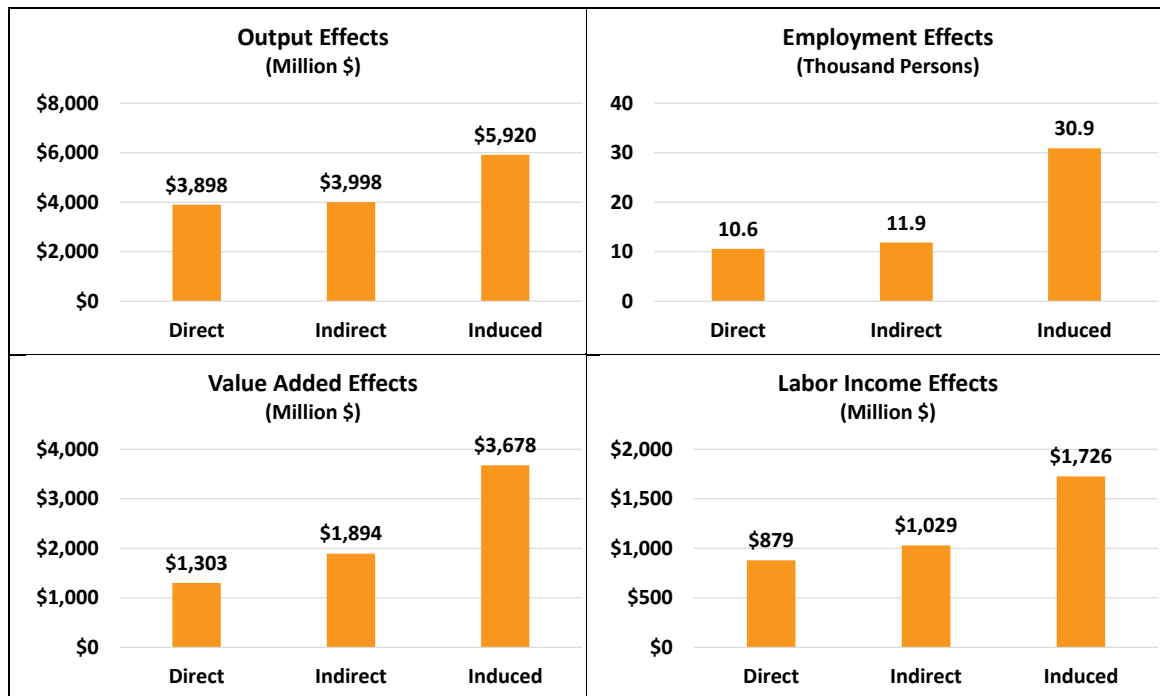


Table 19 shows a summary of the downstream analysis by state. Downstream impacts are more evenly distributed across states than direct production impacts, and tend to follow the distribution of demand for the product, especially at the retail level.

Table 19. Summary of State-Level Downstream Analysis

State	Direct State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		21,196	11,290	30,898	63,385	108,091	48,630	154,642	311,363	14,317	6,367	18,277	38,961	6,744	3,341	8,540	18,625
1 Alabama	1.2%	316	132	348	795	1,610	567	2,021	4,197	213	74	211	498	100	41	101	242
2 Alaska	0.1%	49	23	104	176	250	98	365	714	33	12	50	95	16	7	23	46
3 Arizona	2.1%	420	203	501	1,123	2,140	873	3,074	6,087	283	117	329	730	134	65	155	354
4 Arkansas	0.9%	195	82	211	489	995	354	1,119	2,468	132	46	123	301	62	25	59	146
5 California	10.2%	2,119	1,310	4,202	7,630	10,804	5,641	17,862	34,307	1,431	727	2,320	4,478	674	423	1,081	2,178
6 Colorado	2.2%	407	225	546	1,178	2,076	968	3,260	6,304	275	130	354	758	130	74	167	370
7 Connecticut	1.2%	250	141	437	829	1,276	608	1,660	3,544	169	79	230	478	80	37	105	222
8 Delaware	0.2%	78	36	117	231	399	156	410	964	53	20	57	131	25	1	25	52
9 Dist. of Columbia	0.0%	15	27	208	250	77	116	455	649	10	12	80	103	5	4	36	44
10 Florida	6.8%	1,464	702	1,491	3,656	7,467	3,022	10,732	21,221	989	413	1,061	2,463	466	232	504	1,202
11 Georgia	3.0%	710	405	847	1,963	3,622	1,747	5,716	11,085	480	233	586	1,299	226	128	277	631
12 Hawaii	0.3%	80	37	137	254	409	159	597	1,166	54	21	74	149	26	12	34	72
13 Idaho	0.4%	104	39	113	256	532	166	620	1,318	70	22	66	158	33	12	31	77
14 Illinois	4.8%	908	551	1,333	2,792	4,628	2,374	6,827	13,830	613	310	840	1,763	289	164	393	846
15 Indiana	2.5%	525	240	582	1,347	2,676	1,033	3,318	7,028	354	135	369	858	167	71	175	413
16 Iowa	0.9%	220	98	304	621	1,121	420	1,411	2,952	148	54	164	367	70	28	77	175
17 Kansas	0.8%	185	96	264	545	946	412	1,179	2,537	125	53	144	323	59	21	66	145
18 Kentucky	1.1%	278	129	334	740	1,417	554	1,712	3,682	188	71	194	453	88	32	91	211
19 Louisiana	1.2%	311	139	434	884	1,586	598	2,144	4,328	210	78	243	531	99	45	116	259
20 Maine	0.3%	99	40	99	238	506	172	609	1,287	67	23	63	153	32	13	30	75
21 Maryland	1.6%	375	199	624	1,198	1,913	857	2,562	5,332	253	112	340	706	119	51	154	325
22 Massachusetts	2.0%	417	244	813	1,475	2,129	1,052	3,101	6,282	282	136	422	840	133	63	193	388
23 Michigan	3.1%	712	342	802	1,856	3,629	1,473	4,755	9,857	481	195	509	1,184	226	113	245	584
24 Minnesota	1.8%	408	226	568	1,202	2,083	972	2,983	6,038	276	127	351	754	130	68	164	362
25 Mississippi	0.5%	183	69	186	437	932	295	1,048	2,275	123	38	110	272	58	20	53	130
26 Missouri	2.0%	451	232	507	1,190	2,301	997	2,881	6,179	305	133	324	761	144	55	149	348
27 Montana	0.3%	76	27	79	182	389	114	442	945	51	15	46	113	24	9	22	55
28 Nebraska	0.7%	158	74	199	431	807	318	991	2,116	107	42	113	261	50	21	53	125
29 Nevada	0.7%	149	76	239	464	760	328	1,098	2,185	101	43	131	274	47	24	60	131
30 New Hampshire	0.6%	151	63	127	341	771	270	749	1,790	102	37	85	224	48	16	39	103
31 New Jersey	3.3%	607	368	970	1,945	3,096	1,584	4,233	8,912	410	208	559	1,176	193	87	254	534
32 New Mexico	0.4%	124	46	169	340	634	198	813	1,645	84	26	91	201	40	15	43	98
33 New York	5.3%	1,042	662	2,467	4,170	5,312	2,850	8,194	16,355	704	363	1,206	2,273	331	159	541	1,031
34 North Carolina	3.4%	727	367	848	1,942	3,706	1,581	5,159	10,446	491	210	553	1,253	231	114	261	606
35 North Dakota	0.3%	74	30	106	210	376	129	411	916	50	17	54	121	23	7	25	55
36 Ohio	4.6%	899	467	1,059	2,426	4,586	2,012	6,485	13,083	607	263	689	1,559	286	140	329	755
37 Oklahoma	0.8%	232	113	348	693	1,182	487	1,701	3,369	157	63	196	415	74	37	93	203
38 Oregon	1.1%	233	121	364	718	1,186	522	1,656	3,363	157	68	198	423	74	32	92	199
39 Pennsylvania	3.9%	833	464	1,225	2,522	4,249	1,997	6,008	12,255	563	259	729	1,551	265	132	340	737
40 Rhode Island	0.3%	61	30	96	187	312	128	376	816	41	17	50	108	19	6	23	47
41 South Carolina	1.3%	332	148	341	822	1,693	639	2,210	4,541	224	85	227	536	106	44	107	257
42 South Dakota	0.3%	76	29	82	187	389	125	417	932	52	17	47	115	24	8	22	55
43 Tennessee	1.8%	452	238	536	1,226	2,307	1,026	3,134	6,468	306	135	354	795	144	67	167	378
44 Texas	10.4%	1,841	1,092	2,913	5,846	9,388	4,705	15,417	29,510	1,243	613	1,831	3,687	586	348	862	1,796
45 Utah	0.9%	191	102	251	544	974	438	1,527	2,939	129	58	160	347	61	33	76	170
46 Vermont	0.2%	35	14	52	101	176	61	222	459	23	8	27	58	11	4	13	27
47 Virginia	2.1%	542	295	822	1,660	2,766	1,271	3,813	7,850	366	167	468	1,002	173	82	213	468
48 Washington	2.4%	456	234	758	1,447	2,326	1,006	3,338	6,669	308	130	421	859	145	73	196	414
49 West Virginia	0.4%	121	43	132	296	619	184	631	1,433	82	24	73	179	39	11	34	83
50 Wisconsin	2.7%	462	210	524	1,196	2,357	904	2,930	6,191	312	119	318	749	147	65	153	366
51 Wyoming	0.1%	41	16	75	132	207	70	265	542	27	9	35	71	13	5	16	34

Table 20. Top Ten States in Total Downstream Employment

	Direct	Indirect	Induced	Total
California	10,804	5,641	17,862	34,307
Texas	9,388	4,705	15,417	29,510
Florida	7,467	3,022	10,732	21,221
New York	5,312	2,850	8,194	16,355
Illinois	4,628	2,374	6,827	13,830
Ohio	4,586	2,012	6,485	13,083
Pennsylvania	4,249	1,997	6,008	12,255
Georgia	3,622	1,747	5,716	11,085
North Carolina	3,706	1,581	5,159	10,446
Michigan	3,629	1,473	4,755	9,857
Other States	50,699	21,229	67,486	139,414
United States	108,091	48,630	154,642	311,363

Table 20 shows that the top states in terms of total downstream employment are the same as the upstream, but with switched ranks. This list roughly follows the ranking of GDP by state. Since the downstream activity is strongly correlated with construction spending, the ranking in this table differs slightly from the ranking by GDP due to the fact that certain states had relatively strong construction spending in 2015.

Table 21. Total Downstream Impacts in California

	Output (Million \$)	Employment (thousand persons)	Value Added (Million \$)	Labor Income (Million \$)
Direct	2,119	10,804	1,431	674
Indirect	1,310	5,641	727	423
Induced	4,202	17,862	2,320	1,081
Total	7,630	34,307	4,478	2,178

Table 21 shows a summary of the downstream impacts in California. Note how the ratio of total employment to direct employment is not nearly as large as the upstream analysis. This is due to the fact that the direct jobs are in wholesale and retail trade, which are both very labor-intensive sectors. Figure 14 shows the same data in graphical form.

Figure 14. Downstream Analysis for California

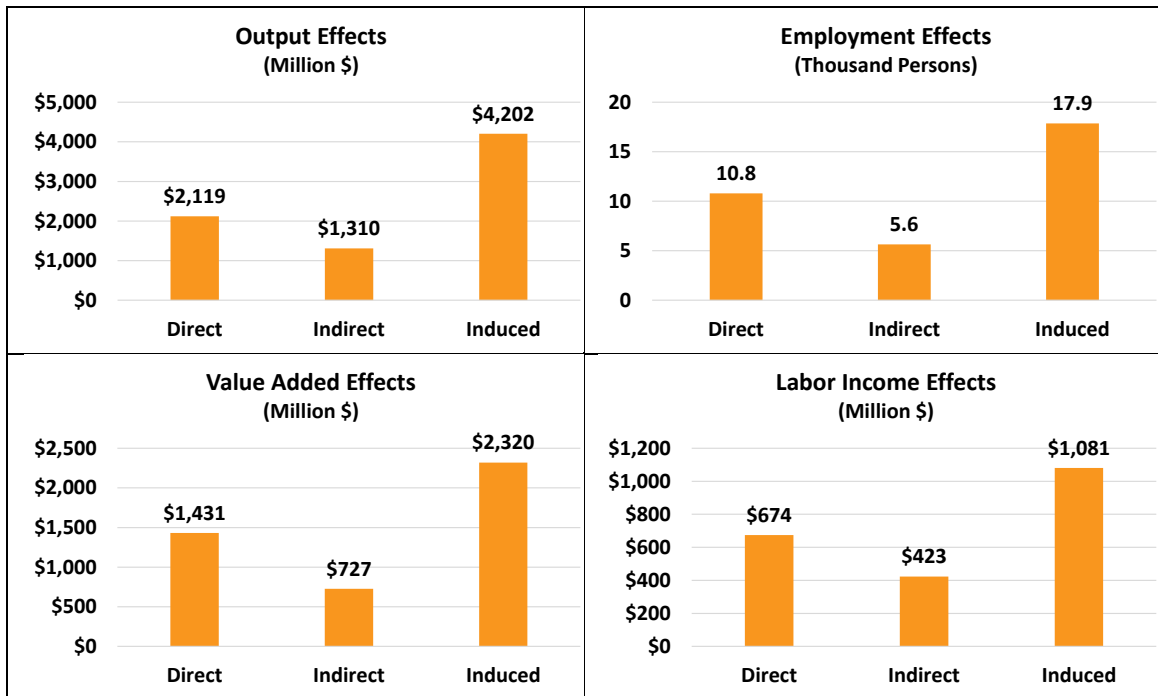
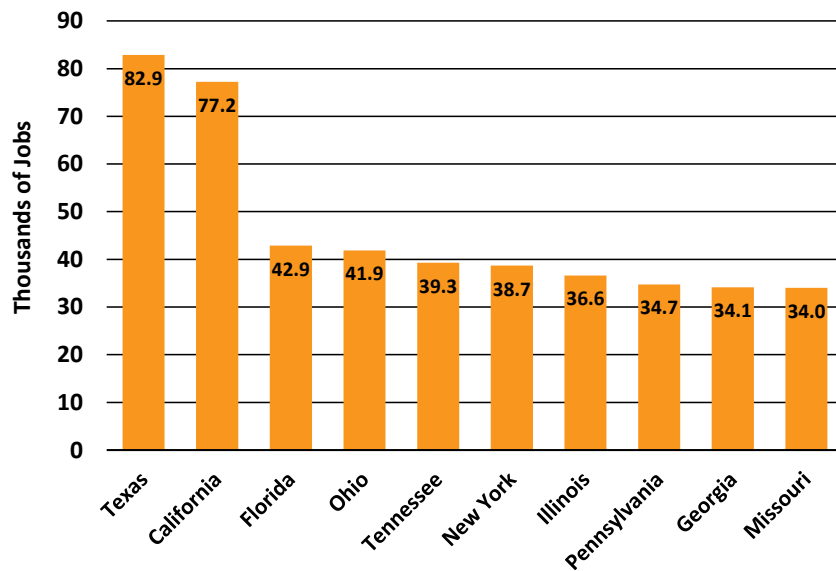


Table 22 provides a ranking of combined upstream and downstream employment impacts by state. The top 5 states make up nearly one-third of the upstream and downstream employment total. Texas and California are heavily represented, comprising 9.4% and 8.7% of the national total, respectively. Figure 15 shows the top ten states. These states are home to over 460 thousand upstream and downstream HVACR jobs.

Table 22. Combined (Upstream and Downstream) Employment State Ranking

Rank	State	Number of Jobs (Upstream + Downstream)	Rank	State	Number of Jobs (Upstream + Downstream)
1	Texas	82,854	27	Mississippi	12,084
2	California	77,237	28	Arizona	12,070
3	Florida	42,871	29	Iowa	11,914
4	Ohio	41,875	30	Kansas	11,430
5	Tennessee	39,300	31	Louisiana	9,322
6	New York	38,683	32	Connecticut	8,199
7	Illinois	36,611	33	Oregon	6,924
8	Pennsylvania	34,742	34	Utah	6,768
9	Georgia	34,128	35	New Hampshire	4,354
10	Missouri	34,024	36	Nevada	4,183
11	North Carolina	31,231	37	Nebraska	4,036
12	Michigan	27,417	38	New Mexico	2,816
13	Wisconsin	26,840	39	Idaho	2,410
14	Indiana	23,742	40	Maine	2,381
15	Oklahoma	22,002	41	West Virginia	2,350
16	Virginia	21,466	42	Hawaii	2,112
17	New Jersey	20,238	43	Dist. of Columbia	2,088
18	Minnesota	19,445	44	Delaware	1,963
19	Washington	15,854	45	North Dakota	1,736
20	South Carolina	14,697	46	South Dakota	1,714
21	Massachusetts	14,668	47	Vermont	1,520
22	Kentucky	14,363	48	Montana	1,495
23	Colorado	13,006	49	Rhode Island	1,482
24	Alabama	12,920	50	Alaska	1,434
25	Arkansas	12,731	51	Wyoming	1,061
26	Maryland	12,302		United States	883,088

Figure 15. Top 10 Combined (Upstream and Downstream) Employment by State



5. Summary and Main Findings

This study has defined the scope of products in four main industry segments comprising the HVACR industry. Using detailed product shipments data from the Census Bureau, we have estimated the appropriate size of the overall industry, and compiled recent historical data on shipments, employment, output, investment, exports and imports, and prices.

Like many industries, the HVACR suffered a large decline in the slowdown in 2009. However, the declines in this industry were larger than in many manufacturing industries due to the close ties with the residential and nonresidential construction sectors. The declines were quite different across sectors, with *HeatingEq* declining 32.9 percent in 2009, and *WaterHeaters* declining by 10 percent. The largest sector *AC/Heat/Refrig* suffered a decline of 12.5 percent in that year. For the period 1997 to 2015, average growth has been about 2 percent per year

Another important finding is the continuing decline in employment in the sector, due partly to continually increasing labor productivity, as well as an increasing share of imports. After reaching a peak of about 190,946 in 2000, employment has since declined to 125,353 in 2015. Real output over the corresponding period has fallen slightly, from \$46,013 million 2015 dollars to \$44,622. Of the total job loss, only about 5,800 has been due to the decline in output, and nearly 60,000 is due to productivity gains. Labor productivity has increased at an average of 2.2 percent per year.

Domestic real output would have grown, if not for the increase in the trade deficit in HVACR, which was nearly in balance as recently as 2000, but is now 7.5 billion dollars in deficit.

Business investment in the sector has been highly volatile, with a steep decline of nearly 16 percent in 2009. The average growth rate of investment over the 1997 to 2015 period has been around 0.9 percent per year. Price inflation in the HVACR sector was about 2 percent over the 1997 to 2015 period.

The HVACR industry is tightly interwoven with other manufacturing sectors and several service sectors that supply important materials, components and parts, as well as financial, IP, management and transportation services. Direct jobs in the HVACR sector were 125,353 in 2015. Reliance on suppliers in other sectors generates an additional 132,079 jobs. Finally, induced impacts of spending of earnings in the direct and indirect sectors contributed to an additional 314,293 jobs, bringing the total jobs impact addressed in this study to 571,725.

Downstream analysis addresses the question of output and jobs generated in the distribution of HVACR products through wholesale and retail outlets. Total direct trade output is the margin or markup earned on sales. This is estimated to be \$21,196 million in 2015, which supports 108,091 direct jobs. An additional 48,630 jobs are supported indirectly, and 154,642 induced jobs. The total downstream jobs impact is estimated at 311,363 jobs.

Combining the upstream and downstream impacts results in total output impact of \$212.4 million and 883,088 jobs. If HVACR installers and mechanics are included, total employment exceeds 1.29 million jobs and output grows to \$256.7 million.

The state-level analysis was performed using a combination of the BEA RIMS II model and the Inforum national and state-level models and databases. The BLS Census of Employment and Wages (CEW) was used to obtain employment distributions by state to estimate the direct state-level impacts.

Both the state-level upstream and downstream analyses sum to the results derived at the national level. In terms of total jobs impact, out of a total national impact of 571,725, the largest state was Texas, with 53,344 jobs, and California, with 42,930 jobs. The top states for downstream impacts were also California, with 34,307 jobs and Texas, with 29,510 jobs. The other top states for the downstream impacts tend to follow more closely the top states in terms of state GDP.

References

- AHRI (2012) *HVACR & Water Heating Industry Statistical Profile*, Air-Conditioning, Heating and Refrigeration Institute.
- Association of Equipment Manufacturers (2014) *The Economic Footprint of the Construction Equipment Industry on the U.S. Economy*. Available for purchase at shop.aem.org/p-591-aem-white-paper-the-economic-footprint-of-the-construction-equipment-industry-on-the-us-economy-2014.aspx.
- Bureau of Economic Analysis (2012) *RIMS II: An Essential Tool for Regional Developers and Planners*, Washington, D.C. Accessed at: https://www.bea.gov/regional/pdf/rims/RIMSII_User_Guide.pdf.
- _____ (2009) *Concepts and Methods of the Input-Output Accounts*. Accessed at https://www.bea.gov/papers/pdf/IOmanual_092906.pdf
- _____ (1997) *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)*, Washington D.C. Accessed at: <https://www.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf>.
- MAPI (2016) *How Important is Manufacturing Today?*, access at: <https://www.mapi.net/forecasts-data/how-important-us-manufacturing-today>.
- Meckstroth, Dan (2016) *The Manufacturing Value Chain is Much Bigger Than You Think!*, MAPI Foundation, February, Arlington, VA, accessed at: https://www.mapi.net/system/files/attachments/files/PA-165_web_0.pdf.
- U.S. Bureau of the Census (2017) *USA Trade Frequently Asked Questions*. Accessed at <https://www.census.gov/foreign-trade/statistics/dataproducts/uto-help/uto-help.html>.
- U.S. Bureau of the Census (2012) *North American Industry Classification System: United States, 2012*, Executive Office of the President, Office of Management and Budget, Bernan Press, Lanham, MD, Access NAICS Related information at <https://www.census.gov/eos/www/naics/>.
- U.S. Bureau of Labor Statistics (2017) *Handbook of Methods*, Quarterly Census of Employment and Wages. Accessed at <https://www.bls.gov/opub/hom/cew/pdf/cew.pdf>.

Appendix A – Data Sources and Methodology

A.1 Data Sources

Inforum relies on a variety of data sources to build its models and produce impact studies. The three most important agencies are the Census Bureau, the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics (BLS). Table A.1 reviews the main data sources used to support this analysis.

Table A.1. Main Data Sources Used for this Study

Agency or Source	Survey or Publication	Frequency	Economic Variables Available
Census Bureau	Economic Census of Manufacturing	Quinquennial	Establishments, Employment, Industry and Product Shipments, Value Added, Payroll, Investment, Inventories, Purchased Inputs
Census Bureau	Annual Survey of Manufacturers	Annual	Establishments, Employment, Industry and Product Shipments, Value Added, Payroll, Investment, Inventories
Census Bureau	USA Trade	Annual	Exports and Imports
BEA	Benchmark Input-Output Table	Quinquennial	Make and Use Tables, 2007 had 393 Commodities
BEA	Gross Output by Industry	Annual	393 Industries, Real, Nominal and Price
BEA	Annual Input-Output Tables	Annual	Make and Use Tables, Consumption and
BLS	Jobs, Hours and Output by Industry	Annual	Employment, Hours, Real and Nominal Output, 193
BLS	Occupational Employment	Every 2 years	Employment by Occupation by Industry
BLS	CEW	Annual	Employment, Wages

Industry data on output, employment, value added, and other variables are organized according to the North American Industry Classification System (NAICS). The first version of NAICS was released for 1997, and since then there have been four more versions, for the years 2002, 2007, 2012, and 2017. Current Economic Census and annual data are for the most part published according to the 2012 NAICS. However, the most recent Benchmark IO table is for 2007, and this is published according to the 2007 version of the NAICS.

Table A.2. Illustration of NAICS 2012

2012 NAICS	Product or industry title
33 Manufacturing (31-33)	
333	Machinery manufacturing
3334	Ventilation, heating, air-conditioning and commercial refrigeration equipment manufacturing
33341	Ventilation, heating, air-conditioning and commercial refrigeration equipment manufacturing
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing
3334153	Commercial refrigerators and related equipment

NAICS is a hierarchical system. All codes beginning with '33' are part of Manufacturing, which includes codes 31, 32 and 33. More digits indicate finer levels of detail. For example, within 33 there are 8 3-digits codes. The code 333 includes all Machinery manufacturing. Within manufacturing as a whole, there are 21 3-digit sub-sectors, 86 4-digit industry groups, 180 5-digit industries, and 270 6-digit industries. At the 6-digit level, the NAICS for the U.S., Canada, and Mexico are consistent. The U.S. Census Bureau employs finer levels of detail in certain publications, such as the Economic Census (EC). The last code in Table A.2 is from the EC 2012 Product Shipments table.

Table A.3. Focus Industries and Economic Census Product Shipments

Census Product Code	Title	Census Product Shipments	Industry Total	AHRI focus	AHRI Share
333413	Industrial and commercial fan and blower and air purification equipment manufacturing	5,711,664	5,711,664		
3334131	x Industrial and commercial fans and blowers	1,826,754		3,932,897	68.9%
3334132	Dust collection and other air purification equipment for industrial gas cleaning systems	1,778,767			
3334133	x Dust collection and other air purification equipment for cleaning incoming air	1,579,249			
333413W	? Industrial and commercial fan and blower and air purification equipment manufacturing, nsk, total	526,894			
333414	Heating equipment (except warm air furnaces) manufacturing	4,826,639	4,826,639		
3334141	x Cast iron heating boilers, radiators, and convectors (excluding electric, automotive, and parts)	680,172		4,826,639	100.0%
3334143	x Domestic heating stoves (excluding electric and parts)	658,710			
3334145	x Steel heating boilers (15 p.s.i. or less) and all other hot water heating boilers (excluding parts)	238,802			
3334147	x Floor and wall furnaces, unit heaters, gas-fired infrared heaters, and mechanical stokers (including parts)	431,217			
333414A	? Other heating equipment, excluding industrial types (including parts for nonelectric heating equipment and oil bu	2,026,236			
333414W	? Heating equipment (except warm air furnaces) manufacturing, nsk, total	791,502			
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufa	29,126,306	29,126,306		
3334152	x Heat transfer equipment (excluding electrically operated dehumidifiers), mechanically refrigerated, self-containe	6,990,116		28,728,335	98.6%
3334153	x Commercial refrigerators and related equipment	3,488,720			
3334155	x Refrigeration condensing units, all refrigerants, excluding ammonia (complete)	728,512			
3334156	Room air conditioners and dehumidifiers, excluding portable dehumidifiers	397,971			
3334159	? All other miscellaneous refrigeration and air-conditioning equipment	962,825			
333415A	x Compressors and compressor units, all refrigerants, excluding automotive	2,565,208			
333415C	x Warm air furnaces, including duct furnaces and humidifiers, and electric comfort heating	2,049,479			
333415D	x Parts and accessories for air-conditioning and heat transfer equipment	1,635,538			
333415E	x Unitary air conditioners, excluding air source heat pumps	6,192,293			
333415F	x Air-source heat pumps, excluding room air conditioners	1,797,099			
333415G	x Ground and ground water source heat pumps (single and split systems)	205,695			
333415W	? Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufa	2,112,850			
335228	Other major household appliance manufacturing	4,384,564	4,384,564		
3352281	x Household water heaters, electric, for permanent installation	957,459		2,208,067	50.4%
3352283	x Household water heaters, excluding electric	1,250,608			
3352285	All other miscellaneous household appliances	2,160,655			
335228W	Other major household appliance manufacturing, nsk, total	15,842			

Table A.3 is an extract of the EC 2012 Product Shipment table for the industries which are the focus of this study. For 2012, detail is provided in this table for Product Shipments down to the 7-digit level. This level of detail is only available in Census years (ending in '2' and '7'), but more aggregate data can be used to link estimates for intervening years. Industries highlighted in red have been identified as focus industries for this study. We use the shares of the more aggregate 6-digit industries to estimate the AHRI universe of industries for the impact analysis. For example, the share used of NAICS 335228 is 50.4 percent.

A.2 Methodology for the National Economic Impact Analysis

The tool used for the national economic impact analysis is the Inforum *Iliad* model, which is a detailed model of the U.S. economy. For each of 352 industries, it shows the demand and supply structure for each industry. The demand structure includes the sales to other industries (intermediate), and sales to final demand. Final demand includes personal consumption (household) expenditures, equipment investment, construction investment (residential and nonresidential), federal and state and local government spending, and exports less imports. The supply structure of each industry includes the other industries it buys from, the labor cost, indirect taxes, and capital income.

The input-output (IO) relationships are arrayed as a matrix, with each industry showing up both as a column and a row of the matrix. Each row of the matrix shows the distribution of sales of that industry's product or service. Each column of the matrix shows the purchases made by that industry.

The *Iliad* model is built on a detailed industry database, which draws from the U.S. Benchmark Input-Output Accounts, the U.S. Annual Input-Output Accounts, gross output by industry, and Census merchandise trade statistics. Both domestic and import prices have been compiled for each sector, so results can be expressed either in nominal (current prices) or real (constant prices) form.

The economic impact analysis consists of several parts:

1. *Upstream analysis* – This traces the impact of a given producing industry on supplier industries, including the suppliers to those suppliers. For each industry, calculations are made on output, jobs, earnings and value added impacts.
2. *Downstream analysis* – This traces the impact of purchases of products through wholesale and retail trade distribution channels. The input-output table is used to estimate the distribution and total level of wholesale and retail trade activity generated through the distribution of a given product.
3. *Induced analysis* – This additional level of impact comes about through the earnings generated in the upstream or downstream industries. It represents the impact of consumer spending from the capital and labor earnings in these industries.

The analysis is done for 2015, and all results are in 2015 dollars. The impact analysis begins with the national output of each industry segment. In the first iteration, all supplier industries' output is calculated, using the input-output coefficients from the column of the matrix. Note that not all of the output of the focus industry goes to domestic suppliers.

Some is supplied by imports, which are calculated in each iteration according to the average import share of that industry. Some of the output is paid out in value added. Both imports and value added can be thought of as leakages that reduce the total output required from domestic suppliers. In each subsequent iteration, the suppliers to the previous round of suppliers are calculated. Because of the leakages just described, the amount necessary to supply each further round becomes smaller and smaller. At some point, the additional supplier output is very small, and the process converges.

Associated with each round of direct and supplier (indirect) output are the employment, earnings and value added necessary to supply that output. When the solution has completed, the model shows the total direct and indirect effects, as well as detailed impacts by supplying industry.

A.3 Methodology for the State-Level Analysis

The first step in preparing the state-level analysis was to derive shares of production by state for each of the producing industry segments, and for the downstream wholesale and retail industries distributing HVACR products. National level *direct* production, employment, value added, and earnings are then distributed to the state level using employment shares taken from the BLS *Census of Employment and Wages* (CEW)¹¹, for both the upstream and the downstream analysis.

In order to calculate the indirect and induced impacts of production, we use the Regional Input-Output Modeling System (RIMS II) multipliers purchased from the Bureau of Economic Analysis.¹² RIMS II is often used by investors, planners and elected officials to assess potential local economic impacts of various projects.

RIMS is based on the 2007 Benchmark Input-Output table produced by the Bureau of Economic Analysis (BEA).¹³ From the benchmark make and use tables, an industry by industry domestic (not including imports) direct requirements matrix is derived at the national level, for 369 industries. The RIMS division at BEA converts this table to the level of a state or defined region using a method known as *location quotient analysis*. This method uses data on employment by industry at the national and regional level to modify the national matrix to be more representative of the target state, metro area or other defined region.

One way to obtain RIMS multipliers for output, employment, labor income (earnings), and value added is to request the multipliers from BEA for any of the 369 industries mentioned above, and results for this industry will be provided for all 50 states plus Washington, D.C. The RIMS products are distributed as spreadsheets that contain multipliers for these 51 regions. For each region, given as a column in the spreadsheets, the rows in the spreadsheet tables represent the effects that activity in the specified sector has on other industries. These other industries are presented at an aggregated industry level, where the economy is composed of 21 sectors, and a set of multipliers for

¹¹ See BLS (2017) for more information on the CEW.

¹² See BEA (2012) and BEA (1997) for more detailed descriptions of RIMS II.

¹³ See <https://www.bea.gov/newsreleases/industry/io/ionewsrelease.htm>, and accompanying materials on the BEA website.

these industries is provided for each state. Table A.4 shows the 21 industries and their NAICS definitions.

The RIMS multipliers can be used to determine within-state indirect impacts (Type I) and induced impacts (Type II). We have used RIMS to calculate direct, indirect and induced upstream within-state impacts for output, employment (jobs), labor income and total value added. These impacts have been calculated for each of the four industry segments comprising the AHRI product scope.

Table A.4 Aggregate Industry Level of RIMS Multipliers

#	Description	NAICS
1	Agriculture, forestry, fishing, and hunting	11
2	Mining	21
3	Utilities	22
4	Construction	23
5	Durable goods manufacturing	33, 321, 327
6	Nondurable goods manufacturing	31, 322, 323, 324, 325, 326
7	Wholesale trade	42
8	Retail trade	44, 45
9	Transportation and warehousing	48,49
10	Information	51
11	Finance and insurance	52
12	Real estate and rental and leasing	53
13	Professional, scientific, and technical services	54
14	Management of companies and enterprises	55
15	Administrative and waste management services	56
16	Educational services	61
17	Health care and social assistance	62
18	Arts, entertainment, and recreation	71
19	Accommodation	721
20	Food services and drinking places	722
21	Other services	81

The sum of the RIMS impacts by state is strictly less than the impacts at the national level. This difference represents out-of-state purchases by businesses, consumers, or governments. Both indirect and induced impacts have an out-of-state component. For the current analysis, the out-of-state impacts were distributed across states in proportion to state GDP.

Tables A.5 to A.8 show state-level impacts for each of the 4 industry segments within the scope of this study. Note that state level totals for direct, indirect, and induced effects sum to the national level analysis described in the previous section.

Although the tables contain a lot of detail, keep in mind that each number in the table is actually the sum of 21 industry level impacts at the RIMS aggregate sector level. The first column in each table shows the share of employment in the target industry in each state. National level direct results were distributed to the states using these shares. Table A.5

shows the state level impacts for NAICS 333413 (*Fans, Blowers, and Air Purifiers*). For this industry the largest state is Wisconsin, with a state employment share of 13.78 percent. Total direct production at the national level is \$4,317 million, with \$595 million in Wisconsin. Using the same state share, we estimate Wisconsin employment at 2,437 jobs, value added at \$273 million, and labor income at \$149.9 million. Indirect output and jobs in Wisconsin from production in this sector is \$323.1 million and 1,065 jobs, respectively. This indirect output represents purchases from other sectors either within-state or out-of-state that affect production, employment, and income in Wisconsin. Aside from its famous dairy industry, Wisconsin is the location for many manufacturing industries that are affected directly or indirectly by *Fans, Blowers, and Air Purifiers*. Induced output in Wisconsin is \$104.2 million, with induced jobs of 2,095. Induced spending is from the incomes earned by workers who are employed either directly or indirectly by the focus industry. Some of this induced impact is within-state, but some is also from consumers in other states, buying Wisconsin cheese, milk, and other agricultural products. Total output in Wisconsin, including direct, indirect, and induced, is \$1,022 million. Total jobs generated in Wisconsin are 5,597.

Table A.9 shows the sum of the 4 industry segments. It is the simple sum of tables A.5 to A.8. For all industry segments together, the state with the largest impacts is Texas, with \$3,898 million of direct output, and the 10,596 jobs supported by upstream activities in Texas represent 8.45 percent of the national total. The second largest state employment share is Tennessee, with 7.03 percent, and this implies \$3,272 million in direct output and 8,812 jobs.

States such as Hawaii that have no direct output still experience indirect and induced impacts due to purchases of Hawaiian goods and services by businesses and consumers in other states. The ratios of indirect to direct, and of induced to direct plus indirect, vary widely by state. This is related, on the one hand, to how much of the industry's suppliers are within-state versus out-of-state, but it also depends on the extent to which the state supplies products to other states' businesses as an upstream supplier or to consumers as induced output.

Table A.10 shows the summary of the downstream analysis at the state level. This includes the jobs, output, value added, and labor income generated through the distribution of the HVACR products. We have used state employment shares for the wholesale industry NAICS 4237 (Refrigeration equipment and supplies merchant wholesalers) and the retail industry NAICS 44411 (Home centers, which includes establishments such as Home Depot and Lowe's). National level downstream output for wholesale and retail distribution of HVACR products has been estimated using the input-output distribution of the 4 industry segments, and using the wholesale and retail trade margins as indicated in that table. The two top states for downstream output shares are Texas (10.4%) and California (10.2%). Once indirect and induced impacts from downstream output are included, the largest state is California, with \$7,630 million in total output impact and 34,307 jobs.

Table A.5 Upstream State Level Summary for NAICS 333413 (FansBlowersAirPur)

State	State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		4,317.4	3,645.3	5,972.2	13,934.9	17,680	11,096	29,880	58,656	1,980.8	1,623.9	3,533.2	7,137.9	1,087.7	858.6	1,651.0	3,597.3
1 Alabama	2.60%	112.4	84.3	67.3	264.1	460	259	560	1,279	51.6	31.2	52.0	134.8	28.3	16.4	25.3	70.0
2 Alaska	0.00%	-	4.9	20.1	24.9	-	7	54	61	-	3.0	8.6	11.6	-	1.8	3.9	5.6
3 Arizona	0.64%	27.7	31.5	96.6	155.9	114	55	350	518	12.7	17.0	47.5	77.2	7.0	9.7	21.7	38.5
4 Arkansas	1.70%	73.2	47.2	40.9	161.3	300	157	301	757	33.6	17.8	29.6	81.0	18.4	8.3	14.4	41.1
5 California	3.82%	164.7	250.0	810.8	1,225.5	675	539	2,645	3,859	75.6	138.4	384.0	598.0	41.5	80.5	175.1	297.1
6 Colorado	1.16%	50.0	41.2	105.3	196.4	205	121	455	781	22.9	21.2	56.9	101.0	12.6	12.0	26.3	50.9
7 Connecticut	0.99%	42.6	41.3	84.5	168.4	174	63	321	558	19.5	19.5	44.3	83.3	10.7	10.2	20.2	41.1
8 Delaware	0.00%	-	5.5	22.5	28.0	-	7	61	68	-	3.3	9.7	13.0	-	2.0	4.3	6.3
9 Dist. of Columbia	0.00%	-	9.7	40.1	49.8	-	13	108	121	-	5.9	17.2	23.1	-	3.6	7.7	11.3
10 Florida	5.20%	224.7	131.3	287.7	643.7	920	478	1,538	2,936	103.1	63.6	172.6	339.3	56.6	34.9	80.6	172.1
11 Georgia	1.85%	79.7	82.5	163.5	325.7	326	194	764	1,284	36.6	38.8	91.7	167.1	20.1	21.7	42.4	84.2
12 Hawaii	0.00%	-	6.4	26.4	32.8	-	9	71	80	-	3.9	11.3	15.2	-	2.3	5.1	7.4
13 Idaho	0.00%	-	5.3	21.7	27.0	-	7	59	66	-	3.2	9.3	12.5	-	1.9	4.2	6.1
14 Illinois	6.78%	292.6	242.6	257.8	793.0	1,198	641	1,678	3,517	134.3	101.5	192.3	428.1	73.7	51.4	90.8	215.9
15 Indiana	5.32%	229.8	161.9	113.1	504.8	941	634	1,030	2,605	105.4	60.5	99.7	265.6	57.9	29.4	48.4	135.7
16 Iowa	0.61%	26.4	26.3	58.6	111.3	108	96	227	431	12.1	12.3	29.4	53.8	6.6	6.6	13.6	26.8
17 Kansas	0.57%	24.6	22.6	50.9	98.1	101	75	199	375	11.3	10.9	26.2	48.3	6.2	5.5	11.9	23.6
18 Kentucky	5.80%	250.3	158.7	65.6	474.6	1,025	567	901	2,493	114.9	54.9	76.4	246.1	63.1	22.9	37.4	123.4
19 Louisiana	0.00%	-	20.3	83.7	103.9	-	27	226	253	-	12.4	35.8	48.2	-	7.4	16.1	23.5
20 Maine	0.00%	-	4.6	19.0	23.7	-	6	51	58	-	2.8	8.2	11.0	-	1.7	3.7	5.4
21 Maryland	0.46%	19.8	33.3	120.5	173.6	81	50	365	496	9.1	19.0	54.9	83.0	5.0	10.6	24.8	40.4
22 Massachusetts	0.83%	35.9	52.9	157.2	246.0	147	67	506	720	16.5	28.2	74.1	118.7	9.1	15.3	33.6	57.9
23 Michigan	3.26%	141.0	108.7	154.9	404.6	577	293	877	1,747	64.7	47.2	96.9	208.8	35.5	25.9	46.3	107.7
24 Minnesota	0.76%	32.7	39.7	109.3	181.7	134	70	395	599	15.0	20.9	54.4	90.3	8.2	11.7	24.9	44.8
25 Mississippi	0.50%	21.5	18.7	35.9	76.1	88	79	155	321	9.9	8.1	18.8	36.8	5.4	4.2	8.8	18.4
26 Missouri	5.20%	224.6	140.7	98.7	464.0	920	518	957	2,394	103.0	54.5	92.3	249.9	56.6	22.9	43.3	122.7
27 Montana	0.00%	-	3.7	15.3	19.0	-	5	41	46	-	2.3	6.6	8.8	-	1.4	3.0	4.3
28 Nebraska	0.39%	17.1	15.4	38.4	70.9	70	53	147	270	7.8	7.6	19.2	34.6	4.3	4.1	8.9	17.3
29 Nevada	0.74%	31.7	18.2	46.1	96.0	130	96	205	431	14.6	9.0	25.1	48.7	8.0	4.8	11.6	24.4
30 New Hampshire	0.00%	-	5.9	24.5	30.5	-	8	66	74	-	3.6	10.5	14.1	-	2.2	4.7	6.9
31 New Jersey	1.41%	60.8	72.7	187.5	321.0	249	93	658	1,001	27.9	36.9	93.6	158.4	15.3	19.0	42.4	76.8
32 New Mexico	0.00%	-	7.9	32.7	40.6	-	11	88	99	-	4.8	14.0	18.8	-	2.9	6.3	9.2
33 New York	2.74%	118.5	161.0	476.8	756.2	485	301	1,525	2,311	54.4	84.6	225.8	364.7	29.9	46.9	101.7	178.4
34 North Caroli	9.78%	422.2	290.0	165.0	877.2	1,729	1,534	1,991	5,254	193.7	109.5	176.4	479.6	106.3	56.2	85.9	248.4
35 North Dakota	0.00%	-	4.9	20.4	25.4	-	7	55	62	-	3.0	8.8	11.8	-	1.8	3.9	5.7
36 Ohio	5.24%	226.3	197.3	204.8	628.4	927	519	1,421	2,867	103.8	80.4	146.2	330.4	57.0	42.4	70.0	169.4
37 Oklahoma	2.99%	129.2	73.0	67.6	269.8	529	337	576	1,442	59.3	27.7	54.8	141.7	32.5	14.7	26.9	74.2
38 Oregon	1.04%	44.8	32.5	70.4	147.6	184	79	310	572	20.6	15.7	38.2	74.5	11.3	8.0	17.7	37.0
39 Pennsylvania	3.54%	152.8	157.5	236.7	547.1	626	330	1,149	2,105	70.1	69.7	140.7	280.6	38.5	36.9	65.5	140.9
40 Rhode Island	0.00%	-	4.5	18.6	23.1	-	6	50	56	-	2.7	8.0	10.7	-	1.6	3.6	5.2
41 South Carolina	1.47%	63.7	53.2	65.9	182.8	261	258	406	924	29.2	21.8	43.0	94.0	16.0	11.4	20.2	47.6
42 South Dakota	0.00%	-	3.8	15.7	19.5	-	5	42	48	-	2.3	6.7	9.0	-	1.4	3.0	4.4
43 Tennessee	1.47%	63.3	61.4	103.3	228.0	259	191	497	947	29.1	27.8	60.7	117.5	16.0	14.6	28.2	58.8
44 Texas	5.16%	222.7	255.7	562.0	1,040.4	912	847	2,352	4,110	102.2	124.6	305.9	532.6	56.1	70.7	141.5	268.3
45 Utah	0.42%	18.1	18.5	48.4	85.1	74	77	196	347	8.3	9.5	24.9	42.8	4.6	5.4	11.5	21.5
46 Vermont	0.00%	-	2.4	10.1	12.5	-	3	27	31	-	1.5	4.3	5.8	-	0.9	1.9	2.8
47 Virginia	1.61%	69.5	63.8	158.7	292.1	285	176	608	1,068	31.9	31.9	81.4	145.2	17.5	16.7	37.0	71.3
48 Washington	0.17%	7.5	37.2	146.1	190.8	31	51	413	495	3.4	22.1	63.9	89.5	1.9	13.2	28.9	43.9
49 West Virginia	0.00%	-	6.2	25.6	31.7	-	8	69	77	-	3.8	10.9	14.7	-	2.3	4.9	7.2
50 Wisconsin	13.78%	595.0	323.1	104.2	1,022.3	2,437	1,065	2,095	5,597	273.0	119.0	163.2	555.2	149.9	57.0	84.4	291.3
51 Wyoming	0.00%	-	3.5	14.5	18.0	-	5	39	44	-	2.1	6.2	8.3	-	1.3	2.8	4.1

Table A.6 Upstream State Level Summary for NAICS 333414 (HeatingEq)

State	State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		5,235.8	5,232.6	7,655.5	18,124.0	15,780	17,220	38,303	71,303	2,031.8	2,490.4	4,529.1	9,051.2	1,139.1	1,355.7	2,116.4	4,611.2
1 Alabama	3.7%	195.7	151.8	86.4	433.9	590	900	869	2,360	76.0	65.2	75.8	217.0	42.6	29.9	37.3	109.8
2 Alaska	0.0%	-	7.3	25.8	33.0	-	8	77	85	-	3.7	11.4	15.1	-	2.9	5.2	8.1
3 Arizona	0.2%	8.6	38.4	123.9	170.9	26	68	397	491	3.4	19.4	56.8	79.6	1.9	14.6	25.9	42.4
4 Arkansas	0.0%	-	14.8	52.1	66.9	-	15	156	171	-	7.5	23.1	30.6	-	5.9	10.5	16.4
5 California	7.2%	378.3	481.1	1,040.4	1,899.7	1,140	1,031	4,171	6,342	146.8	240.0	547.7	934.5	82.3	152.3	253.6	488.2
6 Colorado	0.5%	25.1	49.6	134.9	209.6	76	106	488	669	9.7	25.0	65.8	100.5	5.5	17.4	30.2	53.1
7 Connecticut	0.8%	44.4	53.6	108.4	206.4	134	110	413	657	17.2	26.2	56.0	99.4	9.7	15.5	25.7	50.8
8 Delaware	0.0%	-	8.2	28.9	37.1	-	9	86	95	-	4.1	12.8	17.0	-	3.3	5.8	9.1
9 Dist. of Columbia	0.0%	-	14.6	51.5	66.1	-	15	154	169	-	7.4	22.8	30.2	-	5.8	10.4	16.2
10 Florida	1.4%	71.1	131.4	368.5	571.0	214	293	1,333	1,840	27.6	66.5	178.7	272.8	15.5	46.3	82.0	143.8
11 Georgia	1.2%	64.1	96.8	209.5	370.5	193	274	873	1,340	24.9	47.7	109.6	182.1	14.0	30.5	50.6	95.1
12 Hawaii	0.0%	-	9.6	33.9	43.4	-	10	101	111	-	4.9	15.0	19.9	-	3.8	6.8	10.7
13 Idaho	0.4%	21.9	15.2	28.0	65.0	66	80	134	280	8.5	7.5	15.4	31.4	4.8	4.0	7.2	16.0
14 Illinois	4.9%	257.4	298.1	330.4	885.9	776	796	1,880	3,452	99.9	139.5	221.2	460.6	56.0	74.4	104.0	234.4
15 Indiana	3.3%	175.3	163.5	144.4	483.2	528	504	969	2,001	68.0	72.7	102.2	242.9	38.1	35.6	48.8	122.5
16 Iowa	2.3%	120.5	90.7	75.6	286.8	363	360	528	1,251	46.8	40.1	52.5	139.4	26.2	17.8	25.2	69.1
17 Kansas	4.1%	216.7	128.7	65.9	411.3	653	687	713	2,053	84.1	61.0	65.7	210.8	47.1	20.9	30.9	98.9
18 Kentucky	2.3%	120.2	100.5	83.0	303.7	362	484	573	1,419	46.6	44.1	58.5	149.3	26.2	19.3	27.8	73.3
19 Louisiana	0.2%	9.6	34.8	107.3	151.8	29	49	346	424	3.7	17.4	49.3	70.4	2.1	12.8	22.5	37.4
20 Maine	0.1%	7.3	9.3	24.4	41.1	22	26	91	139	2.8	4.7	12.0	19.5	1.6	3.1	5.5	10.2
21 Maryland	0.5%	28.2	53.8	154.6	236.5	85	73	518	675	10.9	27.0	73.3	111.2	6.1	18.3	33.4	57.8
22 Massachusetts	3.4%	180.6	148.4	201.6	530.7	544	310	1,005	1,859	70.1	72.9	122.6	265.6	39.3	34.6	56.8	130.6
23 Michigan	1.8%	93.8	122.0	198.4	414.2	283	355	907	1,544	36.4	57.6	109.0	202.9	20.4	34.7	51.3	106.3
24 Minnesota	6.9%	360.3	260.5	142.4	763.1	1,086	1,306	1,575	3,967	139.8	124.3	150.6	414.7	78.4	55.6	72.8	206.8
25 Mississippi	0.0%	-	13.0	45.9	58.9	-	14	137	151	-	6.6	20.4	27.0	-	5.2	9.3	14.4
26 Missouri	2.3%	120.5	107.8	125.7	354.0	363	359	731	1,454	46.8	51.7	81.6	180.0	26.2	24.5	37.8	88.5
27 Montana	0.0%	1.5	5.6	19.6	26.7	4	1	59	65	0.6	2.2	8.7	11.5	0.3	1.9	4.0	6.2
28 Nebraska	0.8%	43.7	33.5	49.4	126.6	132	169	252	552	16.9	16.0	28.7	61.6	9.5	8.3	13.5	31.3
29 Nevada	0.1%	6.2	18.7	59.1	84.1	19	37	191	247	2.4	9.5	27.2	39.1	1.4	6.9	12.4	20.7
30 New Hampshire	1.4%	75.1	44.0	31.5	150.6	226	155	253	634	29.1	21.5	26.2	76.8	16.3	7.3	12.3	35.9
31 New Jersey	2.0%	103.2	127.4	240.5	471.1	311	232	976	1,519	40.1	62.5	129.2	231.8	22.5	34.8	59.2	116.4
32 New Mexico	0.0%	-	11.9	41.9	53.7	-	12	125	138	-	6.0	18.6	24.6	-	4.7	8.4	13.2
33 New York	5.4%	281.8	296.2	611.6	1,189.6	849	544	2,351	3,745	109.4	147.6	319.3	576.3	61.3	84.0	145.1	290.4
34 North Carolina	3.4%	176.0	167.2	210.0	553.1	530	821	1,220	2,572	68.3	78.4	133.8	280.5	38.3	42.2	63.1	143.6
35 North Dakota	0.3%	15.7	11.8	26.2	53.7	47	24	102	173	6.1	5.9	13.4	25.4	3.4	3.0	6.1	12.6
36 Ohio	6.3%	330.2	325.4	262.8	918.4	995	1,059	2,024	4,077	128.1	146.7	200.1	475.0	71.8	73.7	96.7	242.2
37 Oklahoma	1.7%	89.2	70.3	86.4	245.9	269	223	515	1,007	34.6	33.2	55.1	123.0	19.4	17.3	26.4	63.1
38 Oregon	0.4%	18.4	35.5	90.1	144.0	56	78	319	453	7.2	17.5	43.4	68.0	4.0	11.6	19.9	35.5
39 Pennsylvania	4.9%	257.8	275.0	303.8	836.5	777	794	1,730	3,301	100.0	127.4	198.3	425.7	56.1	66.1	93.3	215.4
40 Rhode Island	0.0%	-	6.7	23.8	30.6	-	7	71	78	-	3.4	10.6	14.0	-	2.7	4.8	7.5
41 South Carolina	3.5%	185.5	140.7	84.8	411.1	559	685	868	2,113	72.0	61.3	77.7	211.0	40.4	27.4	37.4	105.2
42 South Dakota	0.3%	13.2	9.8	20.2	43.1	40	46	86	171	5.1	4.8	10.7	20.6	2.9	2.7	5.0	10.5
43 Tennessee	7.0%	365.6	285.3	133.6	784.5	1,102	1,462	1,624	4,187	141.9	129.6	151.7	423.1	79.5	55.9	73.6	209.1
44 Texas	2.7%	140.2	292.2	720.2	1,152.6	423	627	2,660	3,710	54.4	144.0	359.5	557.9	30.5	97.8	165.5	293.8
45 Utah	2.5%	129.5	91.7	62.5	283.8	390	519	669	1,578	50.3	43.9	58.9	153.1	28.2	21.0	28.8	77.9
46 Vermont	1.8%	95.5	34.4	13.1	143.0	288	227	228	742	37.1	15.7	17.9	70.7	20.8	3.8	8.9	33.4
47 Virginia	0.0%	-	57.6	203.4	261.0	-	60	608	668	-	29.2	90.3	119.4	-	23.0	41.0	64.0
48 Washington	5.5%	288.5	166.3	188.2	643.0	869	764	1,259	2,892	111.9	81.4	136.9	330.2	62.8	38.5	65.0	166.2
49 West Virginia	0.0%	-	9.3	32.8	42.1	-	10	98	108	-	4.7	14.5	19.2	-	3.7	6.6	10.3
50 Wisconsin	2.3%	119.3	107.5	129.7	356.4	359	418	735	1,512	46.3	50.6	80.3	177.2	25.9	26.6	38.5	91.0
51 Wyoming	0.0%	-	5.3	18.6	23.8	-	6	56	61	-	2.7	8.2	10.9	-	2.1	3.7	5.8

Table A.7 Upstream State Level Summary for NAICS 333415 (AC/Heat/Refrig)

State	State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		32,604.4	30,380.3	45,509.2	108,493.9	85,417	96,696	227,690	409,802	10,426.1	14,459.3	26,923.1	51,808.5	7,252.9	7,576.7	12,581.1	27,410.7
1 Alabama	1.0%	331.9	329.9	511.6	1,173.5	870	1,284	2,465	4,619	106.1	151.1	286.4	543.6	73.8	84.1	134.3	292.3
2 Alaska	0.0%	-	37.8	153.1	190.9	-	58	460	519	-	20.9	68.7	89.6	-	18.8	31.2	50.0
3 Arizona	0.8%	270.3	281.0	736.6	1,288.0	708	936	2,949	4,593	86.4	147.9	380.8	615.1	60.1	97.8	175.6	333.6
4 Arkansas	3.2%	1,047.2	700.1	313.7	2,060.9	2,744	3,177	3,301	9,222	334.9	295.5	290.3	920.6	233.0	92.3	143.7	469.0
5 California	3.7%	1,200.6	2,006.0	6,180.4	9,387.0	3,145	4,508	21,417	29,071	383.9	1,073.9	3,000.3	4,458.2	267.1	804.6	1,374.9	2,446.5
6 Colorado	0.9%	304.1	320.7	802.4	1,427.2	797	859	3,303	4,959	97.2	169.2	421.7	688.1	67.6	110.6	194.8	373.0
7 Connecticut	0.4%	138.3	223.3	644.3	1,005.9	362	499	2,179	3,041	44.2	116.4	310.3	470.9	30.8	83.5	141.4	255.7
8 Delaware	0.2%	53.2	54.2	171.9	279.4	139	59	574	773	17.0	28.9	81.7	127.6	11.8	17.5	37.0	66.3
9 Dist. of Columbia	0.0%	-	75.6	306.0	381.6	-	116	921	1,037	-	41.8	137.2	179.0	-	37.7	62.3	100.0
10 Florida	3.3%	1,078.2	915.5	2,191.6	4,185.2	2,825	3,171	9,651	15,647	344.8	482.0	1,181.9	2,008.7	239.9	294.8	547.6	1,082.3
11 Georgia	5.6%	1,809.6	1,408.3	1,249.3	4,467.2	4,741	5,095	10,129	19,964	578.7	652.1	988.1	2,218.8	402.5	288.9	469.9	1,161.3
12 Hawaii	0.0%	-	49.7	201.2	251.0	-	77	605	682	-	27.5	90.3	117.7	-	24.8	41.0	65.7
13 Idaho	0.0%	16.1	45.1	165.7	226.9	42	94	530	666	5.1	24.6	76.2	106.0	3.6	20.3	34.7	58.6
14 Illinois	2.7%	881.3	1,093.8	1,961.8	3,936.9	2,309	2,899	8,513	13,721	281.8	533.6	1,098.1	1,913.5	196.0	317.7	508.9	1,022.6
15 Indiana	3.3%	1,073.9	981.7	858.4	2,914.0	2,813	3,167	5,650	11,631	343.4	433.7	602.2	1,379.3	238.9	194.1	287.2	720.1
16 Iowa	2.2%	716.9	538.6	449.2	1,704.6	1,878	2,217	3,023	7,118	229.2	234.8	306.8	770.9	159.5	92.1	146.3	397.9
17 Kansas	2.1%	679.2	464.6	389.6	1,533.4	1,779	1,808	2,674	6,262	217.2	214.2	281.0	712.4	151.1	73.0	130.3	354.5
18 Kentucky	1.8%	573.6	497.2	492.3	1,563.2	1,503	1,602	2,918	6,023	183.4	218.4	316.6	718.5	127.6	92.3	149.4	369.3
19 Louisiana	0.8%	268.4	258.5	638.4	1,165.3	703	840	2,518	4,061	85.8	132.3	324.3	542.4	59.7	83.3	150.5	293.5
20 Maine	0.2%	53.2	48.8	145.3	247.2	139	157	547	843	17.0	26.2	72.1	115.2	11.8	17.6	33.3	62.6
21 Maryland	1.3%	439.8	362.8	919.0	1,721.6	1,152	729	3,510	5,391	140.7	189.8	474.6	805.1	97.8	107.9	216.5	422.3
22 Massachusetts	0.5%	172.2	366.4	1,198.2	1,736.9	451	631	3,922	5,004	55.1	196.0	563.6	814.7	38.3	149.4	256.7	444.4
23 Michigan	3.3%	1,062.5	995.2	1,180.7	3,238.5	2,784	3,565	6,724	13,073	339.8	463.3	741.1	1,544.2	236.4	238.7	354.0	829.1
24 Minnesota	2.1%	692.1	616.7	836.0	2,144.8	1,813	1,768	4,488	8,070	221.3	301.2	524.8	1,047.3	154.0	151.4	246.0	551.4
25 Mississippi	3.3%	1,090.8	635.2	276.3	2,002.2	2,858	2,970	3,288	9,115	348.8	257.1	272.1	878.0	242.6	64.9	135.2	442.8
26 Missouri	8.3%	2,695.9	1,880.0	756.0	5,331.9	7,063	7,036	9,626	23,275	862.1	839.1	872.4	2,573.5	599.7	247.1	411.8	1,258.6
27 Montana	0.0%	-	28.9	116.8	145.7	-	44	351	396	-	15.9	52.4	68.3	-	14.4	23.8	38.2
28 Nebraska	0.0%	-	72.3	292.5	364.7	-	111	880	991	-	39.9	131.2	171.1	-	36.0	59.5	95.5
29 Nevada	0.0%	-	86.9	351.5	438.4	-	134	1,058	1,191	-	48.0	157.7	205.7	-	43.3	71.6	114.8
30 New Hampshire	0.5%	167.4	125.0	187.1	479.5	439	392	880	1,711	53.5	60.6	108.4	222.5	37.2	25.9	50.0	113.1
31 New Jersey	1.6%	506.5	601.4	1,429.2	2,537.1	1,327	1,283	5,369	7,979	162.0	307.6	734.8	1,204.4	112.7	188.3	335.1	636.1
32 New Mexico	0.0%	15.3	61.5	248.9	325.7	40	55	749	844	4.9	29.1	111.7	145.6	3.4	27.2	50.7	81.3
33 New York	1.3%	407.7	1,053.5	3,634.1	5,095.3	1,068	1,793	11,583	14,444	130.4	565.6	1,689.5	2,385.4	90.7	451.2	766.8	1,308.7
34 North Caroli	2.7%	870.3	856.4	1,247.3	2,973.9	2,280	2,606	6,456	11,342	278.3	404.9	744.6	1,427.8	193.6	218.9	348.6	761.1
35 North Dakota	0.0%	-	38.5	155.8	194.3	-	59	469	528	-	21.3	69.9	91.2	-	19.2	31.7	50.9
36 Ohio	4.9%	1,613.0	1,621.4	1,560.1	4,794.5	4,226	4,971	10,263	19,459	515.8	728.8	1,075.3	2,319.9	358.8	354.6	513.7	1,227.2
37 Oklahoma	5.6%	1,815.9	1,079.8	518.4	3,414.0	4,757	4,872	6,311	15,940	580.7	472.8	544.3	1,597.8	403.9	158.2	273.2	835.4
38 Oregon	0.2%	69.1	158.5	535.2	762.8	181	351	1,761	2,294	22.1	85.4	250.3	357.8	15.4	67.0	114.2	196.6
39 Pennsylvania	3.8%	1,237.9	1,343.7	1,804.5	4,386.1	3,243	3,655	9,028	15,926	395.9	626.1	1,087.2	2,109.2	275.4	330.9	507.6	1,113.9
40 Rhode Island	0.0%	-	35.0	141.6	176.6	-	54	426	480	-	19.3	63.5	82.9	-	17.4	28.8	46.3
41 South Carolina	1.6%	536.4	469.2	502.6	1,508.1	1,405	1,649	3,157	6,211	171.5	208.9	332.5	712.9	119.3	98.3	156.5	374.1
42 South Dakota	0.1%	17.9	34.9	119.9	172.6	47	80	392	519	5.7	18.8	55.8	80.4	4.0	14.7	25.5	44.2
43 Tennessee	8.3%	2,699.5	2,006.0	794.9	5,500.4	7,072	8,580	10,597	26,249	863.2	885.9	974.8	2,723.8	600.5	303.1	475.3	1,378.9
44 Texas	10.4%	3,390.8	3,250.9	4,290.6	10,932.3	8,883	9,787	24,182	42,852	1,084.3	1,537.8	2,808.0	5,430.1	754.3	814.2	1,324.1	2,892.6
45 Utah	0.2%	63.2	118.4	368.8	550.5	166	267	1,301	1,734	20.2	63.1	177.8	261.1	14.1	48.1	81.5	143.6
46 Vermont	0.0%	-	19.0	76.9	95.9	-	29	231	261	-	10.5	34.5	45.0	-	9.5	15.7	25.1
47 Virginia	3.3%	1,088.8	786.4	1,210.9	3,086.1	2,852	2,410	6,022	11,285	348.2	382.2	722.1	1,452.5	242.2	174.5	332.0	748.7
48 Washington	0.7%	233.1	351.6	1,114.2	1,698.9	611	853	3,832	5,296	74.5	188.1	536.6	799.2	51.8	140.4	245.5	437.7
49 West Virginia	0.0%	-	48.1	194.8	243.0	-	74	586	660	-	26.6	87.4	114.0	-	24.0	39.7	63.6
50 Wisconsin	3.7%	1,222.2	919.3	773.1	2,914.6	3,202	3,218	5,586	12,007	390.8	425.6	560.0	1,376.5	271.9	178.4	273.3	723.6
51 Wyoming	0.0%	-	27.3	110.4	137.7	-	42	332	374	-	15.1	49.5	64.6	-	13.6	22.5	36.1

Table A.8 Upstream State Level Summary for NAICS 335228 (WaterHeaters)

State	State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		2,464.5	2,330.8	3,681.4	8,476.6	6,476	7,067	18,421	31,964	1,056.5	1,024.8	2,178.0	4,259.3	652.9	547.4	1,017.7	2,218.0
1 Alabama	1.5%	36.0	38.0	41.4	115.4	95	115	256	466	15.4	16.7	26.7	58.9	9.5	8.9	12.7	31.2
2 Alaska	0.0%	-	4.2	12.4	16.6	-	13	43	56	-	1.8	6.0	7.8	-	1.0	2.7	3.7
3 Arizona	0.7%	17.5	25.6	59.6	102.7	46	78	256	380	7.5	11.2	32.0	50.8	4.6	6.0	14.8	25.5
4 Arkansas	0.0%	-	8.5	25.1	33.6	-	26	87	113	-	3.7	12.0	15.8	-	2.0	5.5	7.5
5 California	9.0%	221.7	257.0	500.7	979.3	583	779	2,296	3,658	95.0	113.0	285.1	493.1	58.7	60.4	132.8	251.9
6 Colorado	0.0%	-	22.0	64.9	86.8	-	67	226	293	-	9.7	31.2	40.8	-	5.2	14.2	19.4
7 Connecticut	2.5%	62.3	17.7	52.1	132.1	164	54	182	399	26.7	7.8	25.1	59.5	16.5	4.1	11.5	32.1
8 Delaware	0.0%	-	4.7	13.9	18.6	-	14	49	63	-	2.1	6.7	8.8	-	1.1	3.1	4.2
9 Dist. of Columbia	0.0%	-	8.4	24.8	33.2	-	25	86	112	-	3.7	11.9	15.6	-	2.0	5.4	7.4
10 Florida	2.8%	69.6	77.5	177.4	324.5	183	235	809	1,227	29.8	34.1	97.6	161.5	18.4	18.2	45.3	81.9
11 Georgia	0.0%	-	34.1	100.7	134.8	-	103	351	455	-	15.0	48.4	63.4	-	8.0	22.1	30.1
12 Hawaii	0.0%	-	5.5	16.3	21.8	-	17	57	74	-	2.4	7.8	10.3	-	1.3	3.6	4.9
13 Idaho	0.3%	7.3	4.5	13.4	25.2	19	14	47	80	3.1	2.0	6.4	11.6	1.9	1.1	2.9	5.9
14 Illinois	6.8%	166.8	180.4	159.1	506.3	438	547	1,105	2,091	71.5	79.3	122.4	273.3	44.2	42.4	58.0	144.6
15 Indiana	2.6%	63.1	23.4	69.1	155.6	166	71	241	478	27.1	10.3	33.2	70.6	16.7	5.5	15.2	37.4
16 Iowa	0.0%	-	12.2	36.1	48.3	-	37	126	163	-	5.4	17.3	22.7	-	2.9	7.9	10.8
17 Kansas	0.9%	23.1	10.6	31.4	65.1	61	32	109	202	9.9	4.7	15.1	29.6	6.1	2.5	6.9	15.5
18 Kentucky	3.1%	75.8	65.8	40.0	181.6	199	199	347	746	32.5	28.9	33.1	94.5	20.1	15.4	15.9	51.4
19 Louisiana	0.4%	8.6	17.5	51.6	77.8	23	53	180	256	3.7	7.7	24.8	36.2	2.3	4.1	11.3	17.7
20 Maine	0.0%	-	4.0	11.8	15.7	-	12	41	53	-	1.7	5.6	7.4	-	0.9	2.6	3.5
21 Maryland	0.6%	14.6	28.4	74.4	117.4	38	86	283	408	6.3	12.5	37.7	56.5	3.9	6.7	17.3	27.8
22 Massachusetts	2.6%	63.0	58.2	97.0	218.2	166	176	460	802	27.0	25.6	56.7	109.2	16.7	13.7	26.2	56.6
23 Michigan	3.8%	94.4	99.3	95.6	289.4	248	301	646	1,195	40.5	43.7	66.8	150.9	25.0	23.3	32.2	80.5
24 Minnesota	2.6%	64.1	58.5	67.7	190.3	168	177	426	772	27.5	25.7	47.0	100.1	17.0	13.7	22.2	52.9
25 Mississippi	1.9%	46.2	7.5	22.1	75.7	121	23	77	221	19.8	3.3	10.6	33.7	12.2	1.8	4.9	18.8
26 Missouri	0.0%	-	20.4	60.2	80.5	-	62	210	271	-	9.0	28.9	37.9	-	4.8	13.2	18.0
27 Montana	0.0%	-	3.2	9.5	12.7	-	10	33	43	-	1.4	4.5	6.0	-	0.8	2.1	2.8
28 Nebraska	0.0%	-	8.0	23.7	31.7	-	24	83	107	-	3.5	11.4	14.9	-	1.9	5.2	7.1
29 Nevada	0.0%	-	9.6	28.5	38.1	-	29	99	128	-	4.2	13.7	17.9	-	2.3	6.3	8.5
30 New Hampshire	1.2%	29.0	5.1	15.1	49.3	76	16	53	145	12.5	2.3	7.3	22.0	7.7	1.2	3.3	12.2
31 New Jersey	2.0%	49.2	61.7	115.7	226.6	129	187	511	827	21.1	27.1	65.0	113.2	13.0	14.5	29.8	57.4
32 New Mexico	0.0%	-	6.8	20.2	27.0	-	21	70	91	-	3.0	9.7	12.7	-	1.6	4.4	6.0
33 New York	4.0%	98.4	128.4	294.2	521.0	259	389	1,180	1,828	42.2	56.5	155.5	254.1	26.1	30.2	71.1	127.3
34 North Caroli	6.4%	156.7	119.9	101.3	377.9	412	364	842	1,617	67.2	52.7	82.2	202.1	41.5	28.2	39.4	109.1
35 North Dakota	0.0%	-	4.3	12.6	16.9	-	13	44	57	-	1.9	6.1	7.9	-	1.0	2.8	3.8
36 Ohio	8.4%	205.9	206.6	126.7	539.1	541	626	1,221	2,389	88.3	90.8	113.4	292.5	54.5	48.5	55.2	158.3
37 Oklahoma	0.9%	21.8	14.0	41.4	77.1	57	42	144	244	9.3	6.2	19.9	35.4	5.8	3.3	9.1	18.1
38 Oregon	0.7%	18.2	14.7	43.3	76.2	48	44	151	243	7.8	6.4	20.8	35.1	4.8	3.4	9.5	17.8
39 Pennsylvania	7.7%	189.2	49.4	145.8	384.3	497	150	508	1,155	81.1	21.7	70.1	172.8	50.1	11.6	32.0	93.7
40 Rhode Island	0.0%	-	3.9	11.5	15.3	-	12	40	52	-	1.7	5.5	7.2	-	0.9	2.5	3.4
41 South Carolina	3.7%	91.0	73.7	40.8	205.6	239	224	444	907	39.0	32.4	39.2	110.7	24.1	17.3	18.9	60.4
42 South Dakota	0.0%	-	3.3	9.7	13.0	-	10	34	44	-	1.4	4.7	6.1	-	0.8	2.1	2.9
43 Tennessee	5.8%	144.1	121.4	64.2	329.6	379	368	702	1,449	61.8	53.4	66.9	182.0	38.2	28.5	32.3	99.0
44 Texas	5.8%	143.9	199.1	346.8	689.8	378	604	1,689	2,671	61.7	87.5	204.3	353.5	38.1	46.8	95.3	180.2
45 Utah	0.6%	13.8	10.1	29.8	53.7	36	31	104	171	5.9	4.4	14.3	24.7	3.7	2.4	6.6	12.6
46 Vermont	0.0%	-	2.1	6.2	8.3	-	6	22	28	-	0.9	3.0	3.9	-	0.5	1.4	1.9
47 Virginia	0.0%	58.1	33.1	97.9	189.1	153	100	341	594	24.9	14.6	47.0	86.5	15.4	7.8	21.5	44.7
48 Washington	1.5%	35.8	30.5	90.1	156.5	94	93	314	501	15.4	13.4	43.3	72.1	9.5	7.2	19.8	36.5
49 West Virginia	0.0%	-	5.3	15.8	21.1	-	16	55	71	-	2.3	7.6	9.9	-	1.3	3.5	4.7
50 Wisconsin	0.0%	175.5	119.7	63.0	358.2	461	363	709	1,533	75.2	52.6	62.3	190.2	46.5	28.1	31.3	105.9
51 Wyoming	7.1%	-	3.0	8.9	12.0	-	9	31	40	-	1.3	4.3	5.6	-	0.7	2.0	2.7

Table A.9 Upstream State Level Summary for the AHRI Product Focus

State	State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		44,622	41,589	62,818	149,029	125,353	132,079	314,293	571,725	15,495	19,598	37,163	72,257	10,133	10,338	17,366	37,837
1 Alabama	1.61%	676	604	707	1,987	2,014	2,558	4,150	8,723	249	264	441	954	154	139	210	503
2 Alaska	0.00%	-	54	211	265	-	85	635	720	-	29	95	124	-	25	43	67
3 Arizona	0.71%	324	377	1,017	1,718	894	1,137	3,952	5,983	110	196	517	823	74	128	238	440
4 Arkansas	2.43%	1,120	771	432	2,323	3,043	3,375	3,845	10,263	368	324	355	1,048	251	109	174	534
5 California	4.42%	1,965	2,994	8,532	13,492	5,543	6,858	30,529	42,930	701	1,565	4,217	6,484	450	1,098	1,936	3,484
6 Colorado	0.86%	379	433	1,107	1,920	1,077	1,152	4,472	6,701	130	225	576	930	86	145	266	496
7 Connecticut	0.67%	288	336	889	1,513	834	725	3,095	4,655	108	170	436	713	68	113	199	380
8 Delaware	0.11%	53	73	237	363	139	90	770	999	17	38	111	166	12	24	50	86
9 Dist. of Columbia	0.00%	-	108	422	531	-	170	1,269	1,439	-	59	189	248	-	49	86	135
10 Florida	3.30%	1,444	1,256	3,025	5,724	4,142	4,176	13,331	21,650	505	646	1,631	2,782	330	394	756	1,480
11 Georgia	4.20%	1,953	1,622	1,723	5,298	5,260	5,666	12,117	23,043	640	754	1,238	2,631	437	349	585	1,371
12 Hawaii	0.00%	-	71	278	349	-	112	835	947	-	39	124	163	-	32	56	89
13 Idaho	0.10%	45	70	229	344	127	195	769	1,092	17	37	107	161	10	27	49	87
14 Illinois	3.77%	1,598	1,815	2,709	6,122	4,721	4,883	13,176	22,780	587	854	1,634	3,076	370	486	762	1,617
15 Indiana	3.55%	1,542	1,330	1,185	4,058	4,449	4,376	7,890	16,715	544	577	837	1,958	352	265	400	1,016
16 Iowa	1.87%	864	668	619	2,151	2,349	2,710	3,903	8,962	288	293	406	987	192	119	193	505
17 Kansas	2.07%	944	626	538	2,108	2,594	2,603	3,696	8,893	322	291	388	1,001	211	102	180	493
18 Kentucky	2.46%	1,020	822	681	2,523	3,089	2,852	4,739	10,681	377	346	485	1,208	237	150	230	617
19 Louisiana	0.60%	287	331	881	1,499	755	969	3,270	4,994	93	170	434	697	64	108	201	372
20 Maine	0.13%	60	67	201	328	161	202	730	1,094	20	35	98	153	13	23	45	82
21 Maryland	1.08%	502	478	1,268	2,249	1,357	938	4,675	6,970	167	248	640	1,056	113	143	292	548
22 Massachusetts	1.04%	452	626	1,654	2,732	1,308	1,185	5,892	8,385	169	323	817	1,308	103	213	373	689
23 Michigan	3.10%	1,392	1,325	1,630	4,347	3,892	4,514	9,154	17,559	481	612	1,014	2,107	317	323	484	1,124
24 Minnesota	2.55%	1,149	975	1,156	3,280	3,201	3,321	6,884	13,407	404	472	777	1,652	258	232	366	856
25 Mississippi	2.45%	1,158	674	380	2,213	3,067	3,085	3,657	9,809	378	275	322	975	260	76	158	494
26 Missouri	6.66%	3,041	2,149	1,040	6,230	8,346	7,975	11,524	27,845	1,012	954	1,075	3,041	683	299	506	1,488
27 Montana	0.00%	1	41	161	204	4	61	484	549	1	22	72	95	0	18	33	51
28 Nebraska	0.16%	61	129	404	594	201	358	1,361	1,920	25	67	190	282	14	50	87	151
29 Nevada	0.12%	38	133	485	657	149	296	1,553	1,998	17	71	224	311	9	57	102	168
30 New Hampshire	0.59%	272	180	258	710	741	571	1,251	2,563	95	88	152	335	61	37	70	168
31 New Jersey	1.61%	720	863	1,973	3,556	2,016	1,795	7,514	11,325	251	434	1,023	1,708	163	257	467	887
32 New Mexico	0.03%	15	88	344	447	40	98	1,032	1,171	5	43	154	202	3	36	70	110
33 New York	2.12%	906	1,639	5,017	7,562	2,661	3,027	16,639	22,328	336	854	2,390	3,581	208	612	1,085	1,905
34 North Caroli	3.95%	1,625	1,434	1,724	4,782	4,951	5,325	10,510	20,785	607	646	1,137	2,390	380	345	537	1,262
35 North Dakota	0.04%	16	59	215	290	47	103	670	820	6	32	98	136	3	25	45	73
36 Ohio	5.34%	2,375	2,351	2,154	6,880	6,689	7,175	14,929	28,792	836	1,047	1,535	3,418	542	519	736	1,797
37 Oklahoma	4.48%	2,056	1,237	714	4,007	5,612	5,475	7,546	18,633	684	540	674	1,898	462	194	336	991
38 Oregon	0.37%	151	241	739	1,131	468	552	2,541	3,561	58	125	353	535	35	90	161	287
39 Pennsylvania	4.10%	1,838	1,826	2,491	6,154	5,143	4,929	12,415	22,487	647	845	1,496	2,988	420	445	698	1,564
40 Rhode Island	0.00%	-	50	195	246	-	79	587	666	-	27	88	115	-	23	40	62
41 South Carolina	1.97%	877	737	694	2,308	2,464	2,816	4,875	10,155	312	324	492	1,129	200	154	233	587
42 South Dakota	0.07%	31	52	165	248	86	141	555	782	11	27	78	116	7	20	36	62
43 Tennessee	7.03%	3,272	2,474	1,096	6,843	8,812	10,601	13,420	32,832	1,096	1,097	1,254	3,447	734	402	609	1,746
44 Texas	8.45%	3,898	3,998	5,920	13,815	10,596	11,865	30,883	53,344	1,303	1,894	3,678	6,874	879	1,029	1,726	3,635
45 Utah	0.53%	225	239	510	973	667	894	2,269	3,830	85	121	276	482	50	77	128	256
46 Vermont	0.23%	95	58	106	260	288	265	508	1,062	37	29	60	125	21	15	28	63
47 Virginia	2.62%	1,216	941	1,671	3,828	3,290	2,746	7,579	13,616	405	458	941	1,804	275	222	431	929
48 Washington	1.28%	565	586	1,539	2,689	1,605	1,761	5,818	9,184	205	305	781	1,291	126	199	359	684
49 West Virginia	0.00%	-	69	269	338	-	108	808	916	-	37	120	158	-	31	55	86
50 Wisconsin	5.15%	2,112	1,470	1,070	4,652	6,459	5,065	9,125	20,649	785	648	866	2,299	494	290	427	1,212
51 Wyoming	0.00%	-	39	152	191	-	61	458	519	-	21	68	89	-	18	31	49

Table A.10 Downstream State Level Summary for the AHRI Product Focus

State	State Employment Share	Output (million \$)				Employment (# of employees)				Value Added (million \$)				Labor Income (million \$)			
		Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
United States		21,195.7	11,290.4	30,898.4	63,384.6	108,091	48,630	154,642	311,363	14,317.0	6,367.0	18,276.7	38,960.7	6,744.3	3,340.5	8,540.1	18,624.9
1 Alabama	1.2%	315.6	131.7	347.7	795.0	1,610	567	2,021	4,197	213.2	74.1	211.1	498.4	100.4	40.6	101.0	242.0
2 Alaska	0.1%	49.1	22.8	103.9	175.8	250	98	365	714	33.1	12.2	49.9	95.3	15.6	7.1	23.1	45.8
3 Arizona	2.1%	419.7	202.6	500.8	1,123.0	2,140	873	3,074	6,087	283.5	117.4	329.1	730.0	133.5	65.2	155.4	354.1
4 Arkansas	0.9%	195.2	82.2	211.2	488.6	995	354	1,119	2,468	131.8	46.3	123.0	301.2	62.1	24.8	58.7	145.6
5 California	10.2%	2,118.6	1,309.7	4,201.8	7,630.1	10,804	5,641	17,862	34,307	1,431.0	727.2	2,319.8	4,478.1	674.1	422.9	1,081.0	2,178.0
6 Colorado	2.2%	407.0	224.8	546.2	1,178.1	2,076	968	3,260	6,304	274.9	129.6	353.8	758.4	129.5	73.6	167.0	370.1
7 Connecticut	1.2%	250.1	141.2	437.4	828.7	1,276	608	1,660	3,544	169.0	78.9	230.3	478.2	79.6	37.2	105.1	221.9
8 Delaware	0.2%	78.3	36.1	116.8	231.2	399	156	410	964	52.9	20.2	57.4	130.5	24.9	1.3	25.4	51.7
9 Dist. of Columbia	0.0%	15.1	27.0	207.6	249.7	77	116	455	649	10.2	12.5	80.4	103.0	4.8	3.7	35.7	44.3
10 Florida	6.8%	1,464.3	701.5	1,490.5	3,656.3	7,467	3,022	10,732	21,221	989.1	413.1	1,060.6	2,462.7	465.9	232.5	503.7	1,202.1
11 Georgia	3.0%	710.3	405.5	847.5	1,963.2	3,622	1,747	5,716	11,085	479.8	233.4	586.0	1,299.2	226.0	128.4	276.7	631.2
12 Hawaii	0.3%	80.2	37.0	136.8	254.0	409	159	597	1,166	54.2	20.7	74.2	149.0	25.5	12.0	34.4	71.9
13 Idaho	0.4%	104.3	38.6	113.2	256.1	532	166	620	1,318	70.4	22.1	65.6	158.1	33.2	12.2	31.2	76.6
14 Illinois	4.8%	907.6	551.3	1,333.0	2,791.8	4,628	2,374	6,827	13,830	613.0	310.0	840.3	1,763.4	288.8	164.2	393.0	846.0
15 Indiana	2.5%	524.8	239.9	582.4	1,347.1	2,676	1,033	3,318	7,028	354.5	134.6	369.1	858.2	167.0	70.9	175.1	412.9
16 Iowa	0.9%	219.7	97.6	304.0	621.4	1,121	420	1,411	2,952	148.4	54.2	163.9	366.5	69.9	28.0	76.8	174.7
17 Kansas	0.8%	185.5	95.6	263.8	545.0	946	412	1,179	2,537	125.3	53.4	144.1	322.8	59.0	20.5	65.9	145.4
18 Kentucky	1.1%	277.8	128.5	334.1	740.5	1,417	554	1,712	3,682	187.7	71.3	194.2	453.1	88.4	31.7	91.0	211.0
19 Louisiana	1.2%	310.9	138.9	433.9	883.7	1,586	598	2,144	4,328	210.0	77.9	243.0	530.9	98.9	44.6	115.6	259.2
20 Maine	0.3%	99.3	39.9	98.9	238.1	506	172	609	1,287	67.1	23.1	62.7	152.8	31.6	13.0	30.2	74.7
21 Maryland	1.6%	375.1	198.9	623.9	1,198.0	1,913	857	2,562	5,332	253.4	112.5	340.4	706.3	119.4	50.7	154.5	324.6
22 Massachusetts	2.0%	417.5	244.2	813.3	1,475.0	2,129	1,052	3,101	6,282	282.0	136.2	422.3	840.5	132.8	62.7	192.9	388.4
23 Michigan	3.1%	711.6	342.0	802.3	1,855.9	3,629	1,473	4,755	9,857	480.7	194.9	508.9	1,184.5	226.4	112.7	245.3	584.4
24 Minnesota	1.8%	408.5	225.6	568.2	1,202.3	2,083	972	2,983	6,038	275.9	126.9	351.0	753.9	130.0	67.9	164.5	362.3
25 Mississippi	0.5%	182.7	68.5	186.0	437.3	932	295	1,048	2,275	123.4	38.4	110.4	272.2	58.1	19.6	52.5	130.3
26 Missouri	2.0%	451.2	231.5	507.5	1,190.2	2,301	997	2,881	6,179	304.8	132.7	323.9	761.3	143.6	55.2	149.4	348.2
27 Montana	0.3%	76.2	26.5	79.5	182.2	389	114	442	945	51.5	15.2	46.4	113.1	24.3	8.8	22.2	55.2
28 Nebraska	0.7%	158.2	73.9	199.4	431.5	807	318	991	2,116	106.9	41.8	112.7	261.4	50.3	21.5	53.1	124.9
29 Nevada	0.7%	149.0	76.1	238.7	463.8	760	328	1,098	2,185	100.6	42.9	130.6	274.2	47.4	23.5	60.4	131.3
30 New Hampshire	0.6%	151.3	62.6	127.0	340.9	771	270	749	1,790	102.2	37.0	85.3	224.5	48.1	15.9	39.4	103.5
31 New Jersey	3.3%	607.0	367.7	970.4	1,945.1	3,096	1,584	4,233	8,912	410.0	207.6	558.8	1,176.4	193.1	86.5	254.0	533.7
32 New Mexico	0.4%	124.2	46.1	169.3	339.6	634	198	813	1,645	83.9	25.7	91.5	201.1	39.5	14.9	43.2	97.6
33 New York	5.3%	1,041.6	661.7	2,467.2	4,170.4	5,312	2,850	8,194	16,355	703.5	363.2	1,206.0	2,272.7	331.4	158.9	540.7	1,031.1
34 North Caroli	3.4%	726.7	367.0	848.1	1,941.9	3,706	1,581	5,159	10,446	490.9	209.6	552.9	1,253.3	231.2	113.7	261.3	606.3
35 North Dakota	0.3%	73.7	30.0	106.0	209.8	376	129	411	916	49.8	16.6	54.1	120.5	23.5	6.5	24.7	54.7
36 Ohio	4.6%	899.3	467.1	1,059.2	2,425.6	4,586	2,012	6,485	13,083	607.4	262.8	689.1	1,559.3	286.1	139.8	329.0	754.9
37 Oklahoma	0.8%	231.7	113.0	348.2	692.9	1,182	487	1,701	3,369	156.5	63.1	195.7	415.3	73.7	36.5	92.9	203.2
38 Oregon	1.1%	232.6	121.1	364.3	718.0	1,186	522	1,656	3,363	157.1	67.9	198.4	423.5	74.0	32.3	92.3	198.6
39 Pennsylvania	3.9%	833.3	463.6	1,225.4	2,522.3	4,249	1,997	6,008	12,255	562.8	259.3	728.9	1,551.0	265.1	131.7	340.4	737.2
40 Rhode Island	0.3%	61.1	29.6	96.1	186.9	312	128	376	816	41.3	16.6	49.9	107.8	19.4	5.5	22.5	47.5
41 South Carolina	1.3%	332.0	148.3	341.3	821.6	1,693	639	2,210	4,541	224.3	84.9	226.5	535.6	105.6	44.4	106.9	256.9
42 South Dakota	0.3%	76.3	29.1	81.8	187.2	389	125	417	932	51.6	16.5	47.0	115.1	24.3	8.4	22.3	55.0
43 Tennessee	1.8%	452.5	238.3	535.6	1,226.3	2,307	1,026	3,134	6,468	305.6	135.1	354.1	794.8	144.0	67.0	166.9	377.8
44 Texas	10.4%	1,840.9	1,092.2	2,913.3	5,846.4	9,388	4,705	15,417	29,510	1,243.5	612.5	1,830.9	3,686.8	585.8	347.9	862.1	1,795.7
45 Utah	0.9%	191.0	101.7	251.2	543.8	974	438	1,527	2,939	129.0	58.1	160.0	347.1	60.8	33.2	75.9	169.8
46 Vermont	0.2%	34.6	14.1	52.3	100.9	176	61	222	459	23.3	7.8	27.0	58.2	11.0	3.9	12.5	27.4
47 Virginia	2.1%	542.5	295.0	822.1	1,659.6	2,766	1,271	3,813	7,850	366.4	167.5	468.0	1,002.0	172.6	82.1	213.5	468.2
48 Washington	2.4%	456.1	233.6	757.8	1,447.4	2,326	1,006	3,338	6,669	308.1	130.1	420.8	858.9	145.1	73.3	195.7	414.1
49 West Virginia	0.4%	121.3	42.7	132.5	296.4	619	184	631	1,433	81.9	24.1	73.1	179.2	38.6	10.8	33.8	83.3
50 Wisconsin	2.7%	462.1	210.0	523.8	1,195.9	2,357	904	2,930	6,191	312.1	118.7	318.4	749.3	147.0	65.3	153.3	365.5
51 Wyoming	0.1%	40.6	16.2	75.0	131.8	207	70	265	542	27.4	8.7	35.2	71.4	12.9	4.9	16.2	34.1