

An Economic Analysis of the U.S. HVACR Equipment and Water Heater Manufacturing Industry

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



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Executive Summary

This report presents an economic analysis of the domestic heating, ventilation, air-conditioning, commercial refrigeration (HVACR) equipment and water heater manufacturing industry. The study provides information on recent trends within the industry, along with its contributions to the U.S. economy in 2021.

The scope was defined using relevant shares of economic data to analyze manufacturing activity of:

- Fans and Air Purification Equipment
- Heating Equipment
- AC and Refrigeration Equipment
- Water Heaters

Sales of HVACR equipment and water heaters grew moderately in 2018 and 2019. A mild contraction in 2020 highlighted the resilience of the industry during a period of pandemic-related turmoil and uncertainty. Sales rebounded in 2021 as normal conditions resumed. As defined in this study, sales grew by an average annual rate of 3.4% between 2017 and 2021.

Following an extended period of job reductions, the industry began adding jobs following the Great Recession of 2008-2009. This trend continued in recent years, with employment increasing by more than ten thousand between 2017 and 2021; total jobs in the industry increased from 125.9 thousand to 137.3 thousand over this span.

This report measures three types of economic activity associated with HVACR equipment and water heater manufacturers:

1. Direct Impacts - Activity generated within the focus industry. In this case, the manufacturing of HVACR equipment and water heaters serves as the direct impact.
2. Indirect Impacts - Activity generated in other industries due to purchases (materials, energy, and services) by the focus industry through their supply chains.

3. Induced Impacts - Activity generated by spending linked to income earned from direct and indirect production.

The impacts of manufacturers and upstream suppliers are displayed below in Table ES-1. When indirect and induced impacts are included, the industry supported 456.6 thousand jobs and generated \$144.4 billion in economic output in 2021.

Table ES-1: Upstream Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Direct	137.3	9.0	16.4	48.5
Indirect	114.0	11.6	20.7	44.1
Induced	205.4	14.2	29.2	51.9
Total	456.6	34.8	66.2	144.4

Source: Inforum

In addition to these upstream impacts, economic activity is generated in wholesale and retail trade (“downstream”) industries that distribute HVACR equipment and water heaters. In this case, the margins earned by wholesalers and retailers serve as the direct impact. A summary of downstream impacts is displayed in Table ES-2. In total, downstream activity supported 247.7 thousand jobs and \$66.9 billion in economic output.

Table ES-2: Downstream Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Direct	84.1	6.1	14.2	23.6
Indirect	56.1	4.7	8.6	16.1
Induced	107.5	7.5	15.3	27.1
Total	247.7	18.2	38.1	66.9

Source: Inforum

The combined impacts are seen in Table ES-3, with total upstream and downstream employment amounting to 704.4 thousand jobs and \$211.3 billion in economic output.

Table ES-3: Combined (Upstream and Downstream) Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Upstream	456.6	34.8	66.2	144.4
Downstream	247.7	18.2	38.1	66.9
Total	704.4	53.1	104.3	211.3

Source: Inforum

The national-level economic impacts 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). Indirect and induced impacts at the state level are estimated using Bureau of Economic Analysis' Regional Input-Output Modeling System (RIMS) data.

Like many industries, HVACR equipment and water heater manufacturers are concentrated in particular regions. This is often due to proximity to suppliers and the availability of skilled workers. Table ES-4 highlights the top 10 states as measured by direct output and total output. With a large and growing economy, Texas ranked first for both direct (\$6.2 billion) and total (\$17.8 billion) output; roughly one-eighth of direct output is found in the Lone Star State. Tennessee ranked second in terms of direct output, but third when indirect and induced output are factored in. California, meanwhile, does not rank in the top ten for direct output but ranks second when indirect and induced impacts are factored in. Other states with sizable output include Missouri, Georgia, and Ohio.

Table ES-4: Upstream Output, Top 10 States

Units: Billion \$ and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Output (Billion \$)	% Share	Rank	State	Output (Billion \$)	% Share
1	Texas	6.2	12.8%	1	Texas	17.8	12.3%
2	Tennessee	3.3	6.7%	2	California	8.3	5.7%
3	Missouri	2.9	6.1%	3	Tennessee	8.1	5.6%
4	Georgia	2.5	5.1%	4	Ohio	7.1	4.9%
5	Oklahoma	2.3	4.8%	5	Missouri	6.9	4.7%
6	Ohio	2.3	4.7%	6	Georgia	6.5	4.5%
7	Wisconsin	2.2	4.6%	7	Pennsylvania	5.9	4.1%
8	North Carolina	2.0	4.2%	8	Illinois	5.7	3.9%
9	Pennsylvania	1.8	3.8%	9	North Carolina	5.6	3.9%
10	Florida	1.6	3.3%	10	Florida	5.5	3.8%
	All Other States	21.3	43.9%		All Other States	67.1	46.5%
	U.S. Total	48.5	100.0%		U.S. Total	144.4	100.0%

Source: Inforum

1. Introduction

The purpose of this study is to quantify the economic contribution of the heating, ventilation, air-conditioning, commercial refrigeration (HVACR) equipment and water heater manufacturing industry in the United States.

1.1 Defining the Industry

The first step in any economic contribution study is to define which industries to analyze. While informative, the 6-digit NAICS¹ data typically available from statistical agencies are too broad to focus on the specific products manufactured by AHRI's members. For example, the industry titled 'Major Household Appliance Manufacturing' produces other equipment like laundry machines, dishwashers, and ovens in addition to water heaters.

In an effort to address this challenge, Inforum used detailed product data available from the Economic Census to estimate relevant shares. This information, released every five years, provides unique levels of detail not usually available in economic data publications. This granularity allows Inforum to estimate the shares of activity that are pertinent to AHRI and its stakeholders. Collectively, we will refer to this activity as the HVACR equipment and water heater manufacturing industry.

Table 1 displays the four components analyzed. These industries and their relevant shares help serve as the foundation of the report. More details, including a listing of specific products, is provided in Appendix A.

¹ NAICS refers to the North American Industry Classification System. Most U.S. economic statistical agencies use this system to classify businesses by industry. More digits in a NAICS code correspond to a more granular industry. Additional information about NAICS can be found at: <https://www.census.gov/naics/>

Table 1: Focus Industries
Units: Relevant Share of Overall Industry

NAICS Code	NAICS Title	Share	Relevant Share Title
333413	Industrial and Commercial Fan and Blower and Air Purification Equipment	72.0%	Fans and Air Purification Equipment
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	98.6%	Heating Equipment
333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial	96.3%	AC and Refrigeration Equipment
335220	Major Household Appliance Manufacturing	12.0%	Water Heaters

Source: Inforum calculations using 2017 and 2012 Economic Census information

While this report focuses on HVACR equipment and water heater manufacturing, it is important to note activity also takes place in related industries. For example, the equipment that is the focus of this analysis is installed and maintained by contractors. Additionally, the automatic environmental control industry produces goods which monitor and control systems, including HVACR equipment and water heaters. Appendix B reviews available data on these two related industries.

1.2 Report Layout

Section 2 of the study provides an overview of recent industry activity. It describes sales, employment, labor compensation, capital investment, and trade.

Section 3 makes use of input-output tables and techniques to judge the total economic contribution of HVACR equipment and water heater manufacturers. The focus industries listed above help support activity in addition to the *direct impacts* reported in official statistics. Indeed, they operate in a dynamic supply chain that buy from and sell to each other. Materials, energy, and services are purchased by the focus industries to support manufacturing efforts; such effects are known as *indirect impacts*. Additionally, a portion of the income earned by direct and indirect employees is spent on goods and services; this activity is known as *induced impacts*.

Section 4 uses Bureau of Economic Analysis RIMS multiplier data to estimate direct, indirect, and induced impacts at the state level.

Section 5 summarizes the report's findings and offers concluding thoughts.

2. Industry Overview

This section provides an overview of recent industry activity, including sales, employment, labor compensation, capital investment, and trade. The information presented represents relevant shares of data published by the Census Bureau. Importantly, dollar figures are in nominal terms and reflect changes in both prices and quantities.

2.1 Industry Sales

Table 2 and Figure 1 summarize recent sales activity for relevant industry segments.

The overall industry recorded moderate growth in both 2018 and 2019, before contracting 0.7% in 2020. This mild dip demonstrated resilience during a period of significant uncertainty during the COVID-19 pandemic. On the supply side, many businesses experienced restrictions on operations. Demand, meanwhile, was relatively strong despite substantial job losses; those with disposable income increasingly opted to invest in their homes. Sales rebounded with 7.6% growth in 2021 as normal conditions began to return.

Of the four segments analyzed, 'AC and Refrigeration Equipment' account for the vast majority of activity in 2021, comprising 73.2% of total sales. This was followed by 'Heating Equipment' (10.9%), 'Fans and Air Purification Equipment' (9.9%), and 'Water Heaters' (6.0%).

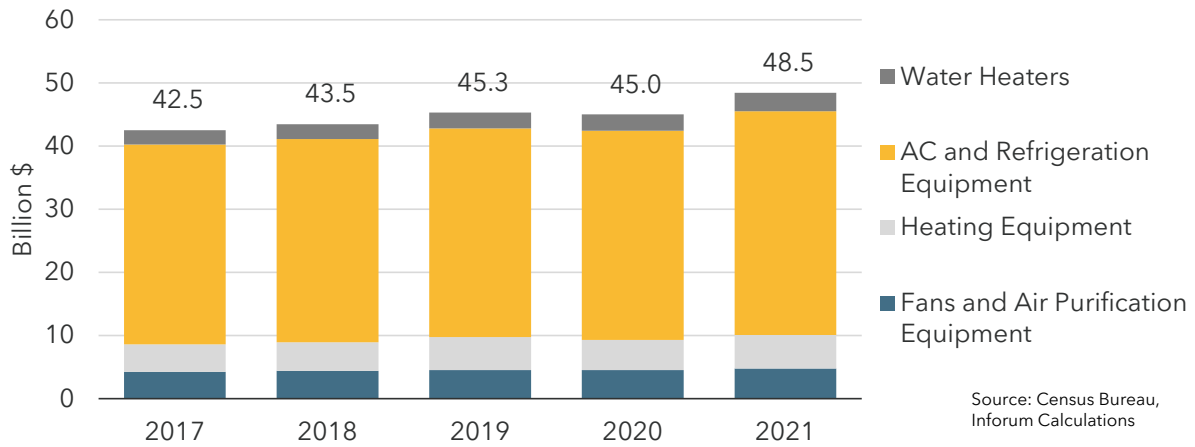
Looking at broader trends, all four industry segments reported positive average annual sales growth between 2017 and 2021. As seen in the final row of Table 2, the most rapid increase was observed in the 'Water Heaters' segment (+6.3%). Growing second swiftest was 'Heating Equipment' (+5.2%), followed by 'Fans and Air Purification Equipment' (+3.1%), and 'AC and Refrigeration Equipment' (+2.9%).

Table 2: Sales by Segment
Units: Billion \$

	Fans and Air Purification Equipment	Heating Equipment	AC and Refrigeration Equipment	Water Heaters	Total	Total Annual % Change
2017	4.3	4.4	31.6	2.3	42.5	
2018	4.4	4.5	32.2	2.4	43.5	2.2%
2019	4.6	5.2	33.1	2.5	45.3	4.2%
2020	4.6	4.8	33.1	2.6	45.0	-0.7%
2021	4.8	5.3	35.5	2.9	48.5	7.6%
2017-2021 Average	3.1%	5.2%	2.9%	6.3%	3.4%	

Source: Census Bureau, Inforum calculations

Figure 1: Sales by Segment
Units: Billion \$



2.2 Employment

Table 3 and Figure 4 highlight HVACR equipment and water heater manufacturing employment over the last half-decade.

According to current estimates, total jobs increased by more than ten thousand between 2017 and 2021, increasing from 125.9 thousand to 137.3 thousand. Recent growth reflects a continuation of trends dating back to 2010 when the industry was still recovering from the Great Recession. Total employment growth accelerated for three consecutive years, including 3.7% growth in 2020, before moderating in 2021.

While each industry segment recorded gains between 2017 and 2021, the bulk of the growth (+9.1 thousand jobs) was observed in the 'AC and Refrigeration Equipment' category. Additionally, this component recorded the quickest average growth over the period (+2.5%).

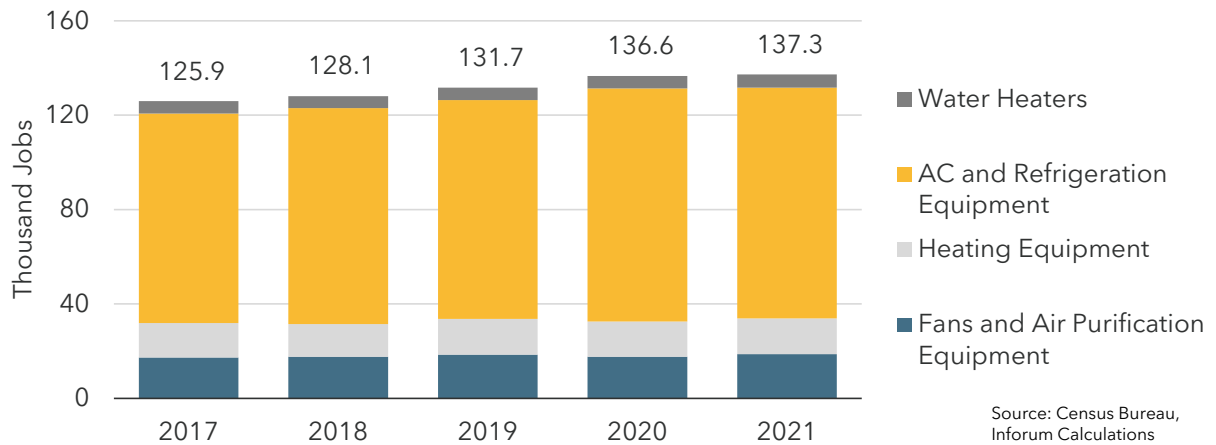
Table 3: Employment by Segment

Units: Thousand Jobs

	Fans and Air Purification Equipment	Heating Equipment	AC and Refrigeration Equipment	Water Heaters	Total	Total Annual % Change
2017	17.3	14.7	88.7	5.2	125.9	
2018	17.6	13.8	91.6	5.1	128.1	1.7%
2019	18.5	15.2	92.7	5.3	131.7	2.8%
2020	17.7	14.9	98.8	5.3	136.6	3.7%
2021	18.8	15.1	97.8	5.6	137.3	0.5%
2017-2021 Average	2.2%	0.9%	2.5%	1.9%	2.2%	

Source: Census Bureau, Inforum calculations

Figure 2: Employment by Segment
Units: Thousand Jobs



2.3 Labor Compensation

Table 4 and Figure 3 display estimated labor compensation among HVACR equipment and water heater manufacturers. Labor compensation includes both wages and benefits earned by employees. This data was derived using information from the Census Bureau and Bureau of Economic Analysis.

Total labor compensation increased from \$7.8 billion in 2017 to \$9.0 billion in 2021. The overall industry recently recorded three consecutive years of about 4.0% growth. The estimated labor compensation and employment figures suggest the average employee in the industry earned more than \$65,300 in 2021².

² (\$8.965 billion in labor income / 137,269 employees) = \$65,310 average labor income

Table 4: Labor Compensation by Segment

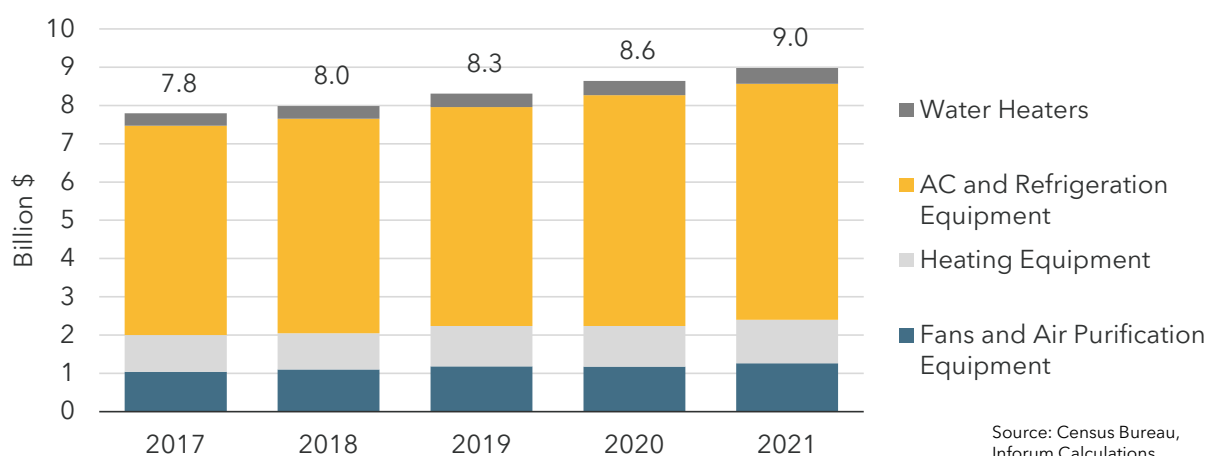
Units: Billion \$

	Fans and Air Purification Equipment	Heating Equipment	AC and Refrigeration Equipment	Water Heaters	Total	Total Annual % Change
2017	1.0	1.0	5.5	0.3	7.8	
2018	1.1	0.9	5.6	0.3	8.0	2.4%
2019	1.2	1.1	5.7	0.3	8.3	4.0%
2020	1.2	1.1	6.0	0.4	8.6	4.0%
2021	1.3	1.1	6.2	0.4	9.0	3.9%
2017-2021 Average	5.0%	4.3%	3.1%	5.6%	3.6%	

Source: Census Bureau, Inforum calculations

Figure 3: Labor Compensation by Segment

Units: Billion \$



Source: Census Bureau, Inforum Calculations

2.4 Capital Expenditures

Table 5 and Figure 4 summarize recent trends in capital expenditures among each of the four industry segments. Capital expenditures track industry spending on structures (excluding the value of land), as well as machinery and equipment (ex: vehicles, computers, and all other machinery).

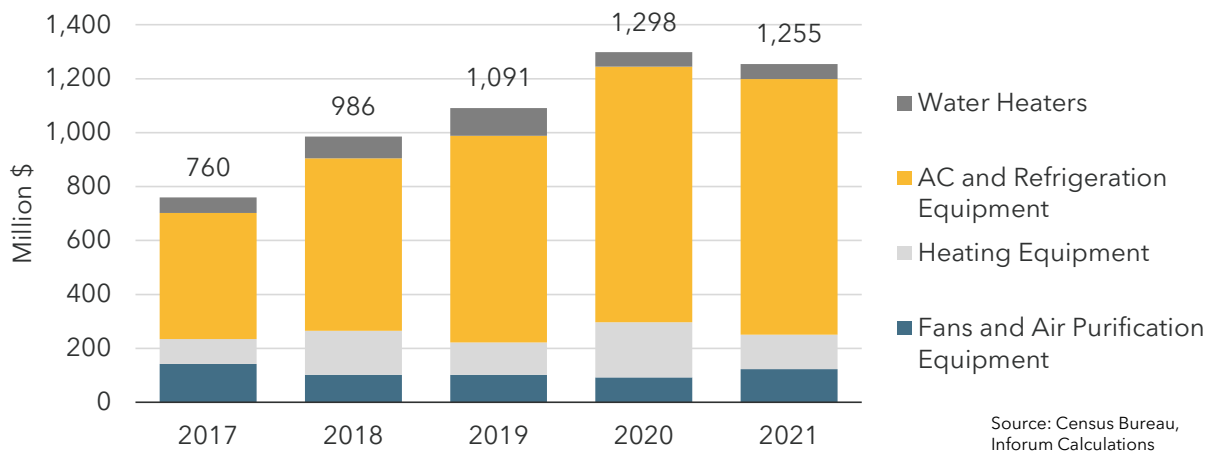
As seen in the final column of Table 5, capital expenditures can change significantly from year to year. Large spikes in investment often mirror the construction of new plants or foreign direct investment by multinational firms. While overall growth turned negative in 2021 (-3.4%), total capital expenditures still exceeded \$1 billion in each of the previous three years.

Table 5: Capital Expenditures by Segment
Units: Million \$

	Fans and Air Purification Equipment	Heating Equipment	AC and Refrigeration Equipment	Water Heaters	Total	Total Annual % Change
2017	142.6	92.0	468.0	57.6	760.2	
2018	102.5	162.6	640.0	80.6	985.8	29.7%
2019	101.9	120.0	766.1	103.3	1,091.3	10.7%
2020	92.9	204.2	947.9	53.5	1,298.4	19.0%
2021	122.9	128.0	948.0	55.6	1,254.5	-3.4%
2017-2021 Average Annual % Change	-3.7%	8.3%	17.6%	-0.9%	12.5%	

Source: Census Bureau, Inforum calculations

Figure 4: Capital Expenditures by Segment
Units: Million \$



Source: Census Bureau, Inforum Calculations

2.5 Exports and Imports

Table 6 and Figure 5 show recent trade activity for HVACR equipment and water heaters. This information reflects relevant shares of Census Bureau’s USA Trade data.

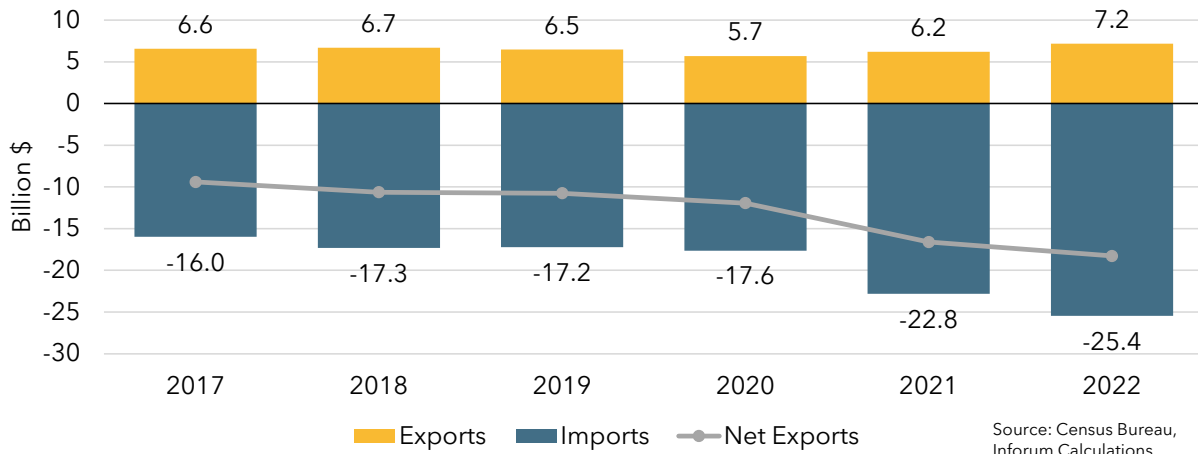
Export values fell in 2020, but have increased in the subsequent two years. Meanwhile, the value of imports has been larger and is growing more rapidly. Consequently, the trade deficit (illustrated as the gray line in Figure 5) has widened each year since 2017, nearly doubling from \$9.4 billion to \$18.3 billion.

Table 6: Exports and Imports
Units: Billion \$

	Exports	Imports	Net Exports
2017	6.6	-16.0	-9.4
2018	6.7	-17.3	-10.6
2019	6.5	-17.2	-10.8
2020	5.7	-17.6	-11.9
2021	6.2	-22.8	-16.6
2022	7.2	-25.4	-18.3

Source: Census Bureau, Inforum calculations

Figure 5: Exports and Imports
Units: Billion \$



3. The National Economic Contribution of HVACR Equipment and Water Heater Manufacturing

The impact of the HVACR equipment and water heater manufacturing industry extends beyond the direct economic impacts as measured by the data presented in the previous section. Economic activity is also supported in upstream industries which provide materials, energy, and various services. Additionally, economic activity is generated downstream of manufacturers through wholesalers and retailers that distribute HVACR equipment and water heaters.

3.1 Metrics and Key Terms

This section describes the concepts being measured, key terms, and other considerations to keep in mind.

Three types of economic impacts are derived in this study:

1. Direct Impacts - Activity generated within the focus industry. In this case, the manufacturing of HVACR equipment and water heaters serves as the direct impact.
2. Indirect Impacts - Activity generated in other industries due to purchases (materials, energy, and services) by the focus industry through the supply chain. For example, an automobile manufacturing firm might purchase tires, steel, and electrical components to produce their final product.
3. Induced Impacts - Activity generated by spending linked to income earned from direct and indirect production.

The concepts measured in this analysis include:

1. Employment - Persons employed by an industry.
2. Labor Income - Labor income is the sum of salary/wages and supplements. Supplements may take the form of employer contributions for employee

- pensions and insurance funds (such as health insurance) and employer contributions for government social insurance (social security).
3. Value Added - Value added is equivalent to the GDP impact and represents the enhancement an industry provides (ex: assembly) to a product/service before offering it to the end consumer. Furthermore, it is the difference between the total revenue of an industry and the cost of intermediate inputs. Components of value added include employee labor compensation, taxes on production and imports, and gross operating surplus (including profits).
 4. Output - Output refers to the total value of all goods and services produced by an industry. This includes both intermediate demand (sales of intermediate inputs to other industries) and final demand (personal consumption, investment, government investment/consumption, and net exports).

Other considerations:

- The results described in subsequent sections describe the economic contribution of HVAC equipment and water heater manufacturers for a single year. For this analysis, the year 2021 was selected because it represents the latest year of data available for many data sources (e.g. Census ASM).
- The COVID-19 pandemic still had a large effect on the economy in 2021 (e.g. modified supply chains, labor force issues, etc.). Some of the changes will prove durable. Others, meanwhile, will be resolved and the economy should return to pre-pandemic conditions.
- Additional methodology notes are available in Appendix C.

3.2 Upstream Impacts

In this analysis, the activity of HVACR equipment and water heater manufacturers serve as the direct impacts. The direct output (\$48.5 billion), employment (137.3 thousand), and labor income (\$9.0 billion) match the 2021 values described in Section 2. These figures are shown in the first row of Table 7.

Using input-output tables and methods, additional impacts can be estimated. The upstream indirect impacts represent the focus industry's purchases of materials, energy, and services. As displayed in the second row of Table 7, indirect output amounted to approximately \$44.1 billion, generating 114.0 thousand jobs, \$20.7 billion in value added, and \$11.6 billion in labor income.

After taxes and savings are removed, employees of direct and indirect firms spend their earnings on a wide variety of goods and services. This activity, known as induced impacts, is shown in the third row of Table 7. Estimated induced impacts include 205.4 thousand jobs, \$14.2 billion in labor income, \$29.2 billion in value added, and \$51.9 billion in output.

Total upstream impacts, displayed in the final row of Table 7, amount to 456.6 thousand jobs, \$34.8 billion in labor income, \$66.2 billion in value added, and \$144.4 billion in output.

With this information at hand, economic multipliers can be calculated. Multipliers are the ratio of indirect and induced activity to activity of the focus industry. The data shown in Table 7 reveals that one job within the overall HVACR equipment and water heater manufacturing industry helps support 2.3³ other jobs in the economy. Additionally, one dollar of the industry's output generates \$1.98⁴ of output elsewhere in the economy.

Table 7: Upstream Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Direct	137.3	9.0	16.4	48.5
Indirect	114.0	11.6	20.7	44.1
Induced	205.4	14.2	29.2	51.9
Total	456.6	34.8	66.2	144.4

Source: Inforum

³ Employment multiplier = (Indirect Employment + Induced Employment) / Direct Employment = (114.0 + 205.4) / 137.3 = 2.3

⁴ Output multiplier = (Indirect Output + Induced Output) / Direct Output = (44.1 + 51.9) / 48.5 = 1.98

Figure 5: Upstream Impact Summary
Units: Thousand Jobs and Billion \$



As previously mentioned, the activity of HVACR equipment and water heater manufacturers stimulates business upstream in the supply chain. This network of transactions helps generate economic output in a unique set of industries.

Table 8 highlights the top industries, as measured by indirect output. Each row represents a particular industry that HVACR equipment and water heater manufacturers purchase from.

Ranked first, 'Wholesale trade' (\$7.4 billion) firms support manufacturers by helping to facilitate the transfer of needed inputs. Second, 'Management of companies and enterprises' (\$2.8 billion) assists in strategic or organizational planning functions. The third and fourth-ranked industries are 'Copper rolling, drawing, extruding, and alloying' (\$2.8 billion) and 'Primary ferrous metal products' (\$2.3 billion), respectively; these industries supply important raw materials used to produce HVACR equipment and water heaters. The top four industries combined are responsible for over one-third of total indirect output.

Table 8: Upstream Indirect Output - Top Industries

Units: Billion \$ and Share of Total

Rank	Industry	Indirect Output (Billion \$)	% Share
1	Wholesale trade	7.4	16.8%
2	Management of companies and enterprises	2.8	6.4%
3	Copper rolling, drawing, extruding and alloying	2.8	6.4%
4	Primary ferrous metal products	2.3	5.2%
5	Search, detection, and navigation instruments	2.0	4.6%
6	Nonferrous metals (except aluminum) smelting and refining	1.2	2.8%
7	Truck transportation	1.2	2.7%
8	Motors and generators	1.0	2.3%
9	Other real estate	1.0	2.2%
10	Advertising, public relations, and related services	0.8	1.8%
11	Electric power generation, transmission, and distribution	0.8	1.8%
12	Aluminum product manufacturing from purchased aluminum	0.8	1.8%
13	Employment services	0.5	1.1%
14	Paperboard containers	0.5	1.1%
15	Paint and coating manufacturing	0.5	1.1%
	All Other Industries	18.5	42.0%
	Total Indirect Output	44.1	100.0%

Source: Inforum

Table 9 lists the top industries, as measured by induced output. Recall that induced activity tracks the spending of labor income earned by direct and indirect employees. Consequently, the industries listed match what a typical household consumes. Major categories include real estate ('Housing services' and 'Other real estate'), health care ('Hospitals' and 'Offices of physicians'), and general personal consumption ('Wholesale trade' and 'Other retail').

Table 9: Upstream Induced Output - Top Industries
Units: Billion \$ and Share of Total

Rank	Industry	Induced Output (Billion \$)	% Share
1	Housing services	5.0	9.6%
2	Hospitals	2.8	5.4%
3	Other retail	2.6	5.0%
4	Wholesale trade	2.4	4.7%
5	Offices of physicians	2.0	3.9%
6	Limited-service restaurants	1.5	2.9%
7	Insurance carriers	1.2	2.3%
8	Full-service restaurants	1.1	2.2%
9	Monetary authorities and depository credit intermediation	1.0	2.0%
10	Automobiles	1.0	1.9%
11	Other financial investment activities	1.0	1.9%
12	Pharmaceuticals and medicines	0.9	1.8%
13	Food and beverage stores	0.9	1.7%
14	General merchandise stores	0.9	1.7%
15	Social assistance, and child day care services	0.8	1.6%
	All Other Industries	26.8	51.6%
	Total Induced Output	51.9	100.0%

Source: Inforum

3.3 Downstream Impacts

In addition to the economic activity attributed to manufacturers and their upstream supply chains, output and employment are supported by the sale of HVACR equipment and water heaters. This activity, described as downstream in this report, uses wholesale and retail margin data from the Bureau of Economic Analysis' input-output tables. Margins represent "the value of the trade services provided in delivering commodities from producers' establishments to purchasers, where the purchaser pays for the services"⁵.

Table 10 and Figure 6 summarize the direct, indirect, and induced impacts associated with downstream sales. The relevant wholesale and retail margins associated with the manufacturing activity (direct impacts) described in Section 3.2 serve as the direct impacts for the downstream analysis. This wholesale and retail activity directly supports 84.1 thousand jobs, \$6.1 billion in labor income, \$14.2 billion in value added, and \$23.6 billion in output.

⁵ <https://www.bea.gov/help/glossary/margin-or-margin-costs>

The wholesale and retail industries involved purchase a unique set of materials, energy, and services. The economic impacts associated with these indirect downstream impacts amount to 56.1 thousand jobs, \$4.7 billion in labor income, \$8.6 billion in value added, and \$16.1 billion in output.

Finally, a share of the income earned by downstream direct and indirect activity enters back into the economy through purchases made by households. These induced impacts are shown in the third row of Table 10. These include 107.5 thousand jobs, \$7.5 billion in labor income, \$15.3 billion in value added, and \$27.1 billion in output.

In total, the downstream impacts total 247.7 thousand jobs, \$18.2 billion in labor income, \$38.1 billion in value added, and \$66.9 billion in output.

Table 10: Downstream Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Direct	84.1	6.1	14.2	23.6
Indirect	56.1	4.7	8.6	16.1
Induced	107.5	7.5	15.3	27.1
Total	247.7	18.2	38.1	66.9

Source: Inforum

Economic multipliers can also be calculated for downstream activity. One downstream job engaging in wholesale/retail of HVACR equipment and water heaters helps support 1.9⁶ other jobs in the economy. Additionally, one dollar of wholesale/retail output generates \$1.83⁷ of output elsewhere in the economy.

⁶ Employment multiplier = (Indirect Employment + Induced Employment) / Direct Employment = (56.1 + 107.5) / 84.1 = 1.9

⁷ Output multiplier = (Indirect Output + Induced Output) / Direct Output = (16.1 + 27.1) / 23.6 = 1.83

Figure 6: Downstream Impact Summary
Units: Thousand Jobs and Billion \$



Table 11 examines the specific industries impacted by downstream indirect output. The largest impact is associated with 'Other real estate' (\$1.9 billion); this would include spending on facilities and land. Ranked second and third are 'Management of companies and enterprises' (\$1.2 billion) and 'Advertising, public relations, and related services' (\$1.1 billion); these services provide strategic guidance and other professional services. The fourth and fifth-ranked industries are 'Wholesale trade' (\$1.1 billion) and 'Warehousing and storage' (\$0.9 billion); these purchases are made to help downstream firms with their own logistics efforts. Combined, the top five industries listed account for more than one-third of all indirect output.

Table 11: Downstream Indirect Output - Top Industries

Units: Billion \$ and Share of Total

Rank	Industry	Indirect Output (Billion \$)	% Share
1	Other real estate	1.9	12.0%
2	Management of companies and enterprises	1.2	7.5%
3	Advertising, public relations, and related services	1.1	7.0%
4	Wholesale trade	0.9	5.3%
5	Warehousing and storage	0.6	3.9%
6	Employment services	0.6	3.5%
7	Electric power generation, transmission, and distribution	0.5	3.3%
8	Insurance carriers	0.4	2.5%
9	Couriers and messengers	0.4	2.5%
10	Scenic and sightseeing transportation and support activities for transportation	0.4	2.2%
11	Monetary authorities and depository credit intermediation	0.3	2.2%
12	Management consulting services	0.3	2.0%
13	Services to buildings and dwellings	0.3	1.9%
14	Accounting, tax preparation, bookkeeping, and payroll services	0.3	1.8%
15	Insurance agencies, brokerages, and related activities	0.3	1.8%
	All Other Industries	6.6	40.7%
	Total Indirect Output	16.1	100.0%

Source: Inforum

Table 12 reviews induced output by industry spurred by downstream activity. This table shares the same rankings with Table 9 but has different dollar values. This similarity is due to the fact it is also measuring the types of goods and services consumed by households. This spending includes significant amounts of housing, healthcare, and general consumption.

Table 12: Downstream Induced Output - Top Industries
Units: Billion \$ and Share of Total

Rank	Industry	Induced Output (Billion \$)	% Share
1	Housing services	2.6	9.7%
2	Hospitals	1.4	5.2%
3	Other retail	1.4	5.0%
4	Wholesale trade	1.3	4.7%
5	Offices of physicians	1.1	3.9%
6	Limited-service restaurants	0.8	2.9%
7	Insurance carriers	0.6	2.3%
8	Full-service restaurants	0.6	2.2%
9	Monetary authorities and depository credit intermediation	0.5	2.0%
10	Automobiles	0.5	1.9%
11	Other financial investment activities	0.5	1.8%
12	Pharmaceuticals and medicines	0.5	1.8%
13	Food and beverage stores	0.5	1.7%
14	General merchandise stores	0.5	1.7%
15	Social assistance, and child day care services	0.4	1.6%
	All Other Industries	14.0	51.7%
	Total Induced Output	27.1	100.0%

Source: Inforum

3.4 Combined (Upstream + Downstream) Impacts

The previous two subsections examined upstream and downstream activity individually. Table 13 displays the sum of these impacts. When the upstream and downstream impacts are combined, activity related to HVACR equipment and water heater manufacturing supports over 700 thousand jobs, \$53 billion in labor income, \$104 billion in value added, and \$211 billion in output.

Table 13: Combined (Upstream + Downstream) Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Direct	221.4	15.1	30.6	72.1
Indirect	170.0	16.3	29.3	60.2
Induced	312.9	21.7	44.4	79.0
Total	704.4	53.1	104.3	211.3

Source: Inforum

4. State-Level Economic Contribution of HVACR Equipment and Water Heater Manufacturing

The national economic impacts described in Section 3 can be seen as the sum of economic impacts at the state level. National-level direct employment, labor income, value added, and output 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.

To calculate the indirect and induced impacts of production, we use the Bureau of Economic Analysis' Regional Input-Output Modeling System (RIMS) ⁸. RIMS data allow economists and other stakeholders to estimate the state-level economic impacts of various economic activities. Additional information regarding state-level methodology is available in Appendix C.

4.1 Upstream State-Level Impacts

This section highlights key takeaways for upstream state-level impacts. Table 14 displays the top 10 states for direct output and total (direct + indirect + induced) output. Please note that the figures listed for the sum of states matches the national-level direct and total output presented in Table 7. The top ten states displayed here represent 56.1% of direct output and 53.5% of total output.

With a large and growing economy, Texas ranked first for both direct (\$6.2 billion) and total (\$17.8 billion) output; roughly one-eighth of direct output is found in the Lone Star State. Tennessee ranked second in terms of direct output, but third when indirect and induced output are factored in. California, meanwhile, does not rank in the top ten for direct output but ranks second when indirect and induced impacts are factored in. Other states with sizable output include Missouri, Georgia, and Ohio.

⁸ More information about BEA RIMS multipliers can be found at: <https://apps.bea.gov/regional/rims/rimsii/>

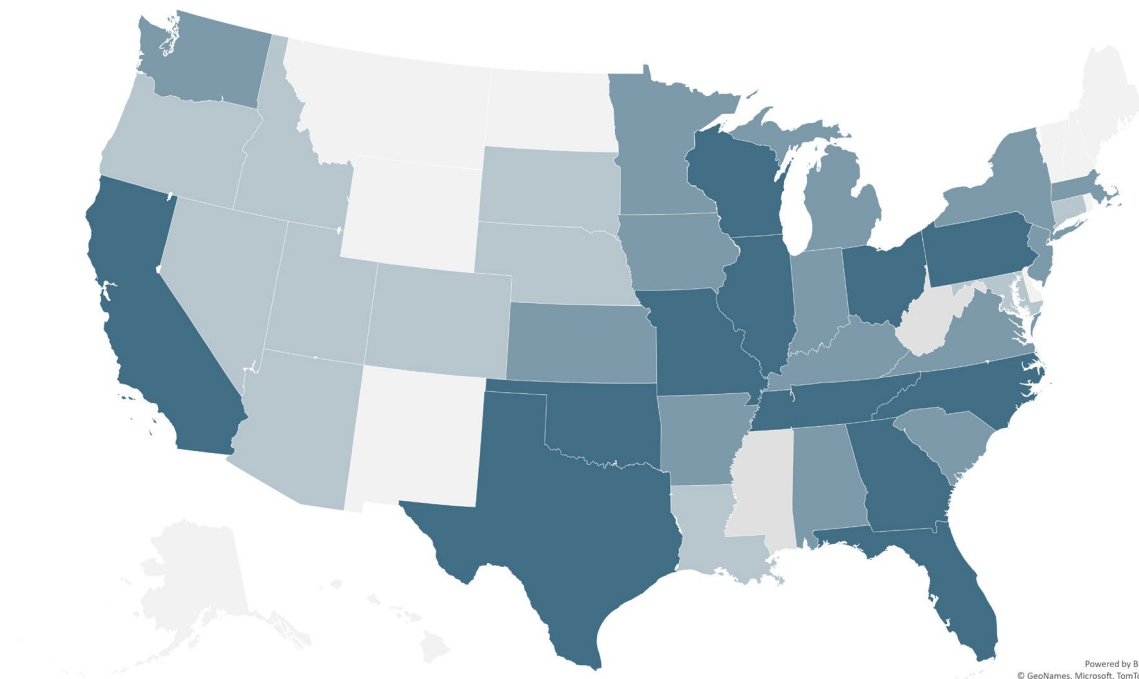
Table 14: Upstream Output, Top 10 States
Units: Billion \$ and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Output (Billion \$)	% Share	Rank	State	Output (Billion \$)	% Share
1	Texas	6.2	12.8%	1	Texas	17.8	12.3%
2	Tennessee	3.3	6.7%	2	California	8.3	5.7%
3	Missouri	2.9	6.1%	3	Tennessee	8.1	5.6%
4	Georgia	2.5	5.1%	4	Ohio	7.1	4.9%
5	Oklahoma	2.3	4.8%	5	Missouri	6.9	4.7%
6	Ohio	2.3	4.7%	6	Georgia	6.5	4.5%
7	Wisconsin	2.2	4.6%	7	Pennsylvania	5.9	4.1%
8	North Carolina	2.0	4.2%	8	Illinois	5.7	3.9%
9	Pennsylvania	1.8	3.8%	9	North Carolina	5.6	3.9%
10	Florida	1.6	3.3%	10	Florida	5.5	3.8%
	All Other States	21.3	43.9%		All Other States	67.1	46.5%
	U.S. Total	48.5	100.0%		U.S. Total	144.4	100.0%

Source: Inforum

Figure 7 illustrates total output values by state by quartile; the top 25% of states have the darkest shading. Table 15 provides a full listing of state-level impacts for output and value added.

Figure 7: Upstream Total Output by State
Note: Shaded by quartile - Darkest signifies largest values



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Table 15: State-Level Upstream Output and Value Added
Units: Million \$

	Output (Million \$)				Value Added (Million \$)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Alabama	770	788	712	2,270	283	320	393	996
Alaska	3	21	80	104	1	6	43	50
Arizona	398	396	811	1,605	132	183	477	792
Arkansas	1,119	833	594	2,546	365	411	327	1,103
California	1,610	2,237	4,418	8,265	543	933	2,509	3,985
Colorado	404	382	763	1,549	132	183	439	754
Connecticut	197	294	441	932	80	110	249	438
Delaware	16	38	113	166	5	14	61	80
Dist. of Columbia	0	21	111	132	0	7	67	75
Florida	1,614	1,287	2,591	5,492	529	648	1,499	2,676
Georgia	2,472	1,970	2,054	6,496	821	993	1,179	2,993
Hawaii	0	37	160	197	0	11	93	104
Idaho	103	96	186	385	34	44	102	181
Illinois	1,611	1,841	2,202	5,654	566	806	1,219	2,590
Indiana	1,538	1,686	1,302	4,526	508	720	700	1,928
Iowa	904	741	592	2,237	302	356	332	990
Kansas	1,029	744	617	2,390	340	386	337	1,062
Kentucky	718	761	680	2,158	260	299	369	928
Louisiana	375	352	693	1,421	123	146	347	616
Maine	53	68	148	270	18	28	84	131
Maryland	534	356	711	1,602	173	189	414	776
Massachusetts	568	563	985	2,116	204	265	569	1,038
Michigan	1,403	1,667	1,510	4,581	501	673	827	2,001
Minnesota	1,393	1,144	1,145	3,681	471	592	643	1,706
Mississippi	757	558	455	1,770	250	262	245	757
Missouri	2,943	2,185	1,722	6,850	963	1,144	980	3,087
Montana	0	33	112	145	0	10	59	69
Nebraska	173	172	264	609	59	75	144	278
Nevada	296	172	376	844	119	80	221	420
New Hampshire	81	110	167	358	28	48	96	171
New Jersey	704	726	1,219	2,649	229	341	689	1,259
New Mexico	2	48	178	228	1	15	102	118
New York	596	898	2,273	3,767	201	366	1,289	1,856
North Carolina	2,043	1,738	1,800	5,581	712	838	1,036	2,586
North Dakota	64	40	101	205	21	13	38	72
Ohio	2,292	2,545	2,259	7,096	795	1,107	1,235	3,138
Oklahoma	2,304	1,249	1,074	4,627	740	721	604	2,064
Oregon	225	307	463	996	74	132	263	470
Pennsylvania	1,844	1,957	2,134	5,934	640	875	1,199	2,714
Rhode Island	135	102	139	376	44	52	81	177
South Carolina	1,467	1,235	1,006	3,708	520	564	576	1,659
South Dakota	165	97	129	392	53	52	73	178
Tennessee	3,264	2,717	2,131	8,112	1,137	1,327	1,209	3,673
Texas	6,188	5,408	6,181	17,777	1,986	2,695	3,443	8,124
Utah	99	194	370	663	37	72	204	314
Vermont	109	58	89	255	37	31	51	119
Virginia	1,072	805	1,102	2,979	348	413	642	1,403
Washington	554	546	889	1,989	187	238	496	921
West Virginia	14	65	159	238	5	20	87	111
Wisconsin	2,229	1,759	1,394	5,383	776	862	785	2,423
Wyoming	0	22	74	96	0	6	38	44
U.S. Total	48,456	44,064	51,881	144,401	16,351	20,685	29,166	66,203

Source: Inforum

Table 16 displays the top 10 states for direct employment and total (direct + indirect + induced) employment. The sum of the states on the bottom line matches the national-level value in Table 7. The top ten states displayed here represent 56.2% of direct employment and 53.5% of total employment.

Direct employment, is displayed on the left side of Table 16. Texas is the largest direct employer. With an estimated 17.6 thousand jobs; this level is roughly twice as many as the next closest state. Tennessee (8.8 thousand) ranks second in terms of direct employment, supplying 6.4% of the national total. Next, Missouri is home to an estimated 8.3 thousand jobs, accounting for 6.0% of the national total. In a sign of industry clustering, these three states are responsible for more than a quarter of all direct HVACR equipment and water heater manufacturing employment.

The top states in terms of total employment are featured on the right side of Table 16. These rankings are similar to direct, with Texas and Tennessee at the top. However, other states like California, Ohio, and Illinois are ranked higher due to the inclusion of indirect and induced impacts.

Table 16: Upstream Employment, Top 10 States
Units: Thousand Jobs and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Employment (Thousand Jobs)	% Share	Rank	State	Employment (Thousand Jobs)	% Share
1	Texas	17.6	12.8%	1	Texas	56.6	12.4%
2	Tennessee	8.8	6.4%	2	Tennessee	26.2	5.7%
3	Missouri	8.3	6.0%	3	California	24.3	5.3%
4	Wisconsin	6.9	5.0%	4	Ohio	22.9	5.0%
5	Georgia	6.8	4.9%	5	Missouri	22.1	4.8%
6	Ohio	6.5	4.7%	6	Georgia	20.3	4.5%
7	Oklahoma	6.4	4.7%	7	Wisconsin	18.6	4.1%
8	North Carolina	6.0	4.4%	8	North Carolina	18.4	4.0%
9	Pennsylvania	5.1	3.7%	9	Pennsylvania	18.2	4.0%
10	Florida	4.7	3.4%	10	Illinois	16.7	3.7%
	All Other States	60.2	43.8%		All Other States	212.3	46.5%
	U.S. Total	137.3	100.0%		U.S. Total	456.6	100.0%

Source: Inforum

Table 17 provides a full listing of state-level impacts on employment and labor income.

Table 17: State-Level Upstream Employment and Labor Compensation
Units: Number of Jobs and Million \$

	Employment (# Jobs)				Labor Compensation (Million \$)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Alabama	2,187	2,366	3,592	8,145	150	175	193	518
Alaska	9	44	105	158	1	9	20	30
Arizona	1,132	1,209	2,567	4,909	73	134	222	430
Arkansas	3,134	2,473	3,162	8,770	199	178	168	545
California	4,692	4,773	14,881	24,346	313	816	1,217	2,345
Colorado	1,197	930	2,249	4,376	77	139	208	424
Connecticut	584	566	1,929	3,079	41	89	120	250
Delaware	45	78	232	354	3	16	31	49
Dist. of Columbia	0	66	121	187	0	15	39	53
Florida	4,716	3,586	7,307	15,609	307	443	714	1,463
Georgia	6,763	5,456	8,117	20,336	432	517	572	1,521
Hawaii	0	88	204	292	0	19	42	61
Idaho	290	276	694	1,261	19	33	50	102
Illinois	4,680	3,693	8,331	16,704	310	493	593	1,396
Indiana	4,517	3,474	7,472	15,463	295	347	345	987
Iowa	2,464	2,037	3,269	7,769	161	165	165	490
Kansas	2,864	2,302	3,172	8,337	187	158	161	506
Kentucky	2,191	1,478	3,390	7,059	145	158	176	480
Louisiana	1,031	837	1,756	3,623	67	97	158	322
Maine	145	181	504	830	10	26	42	77
Maryland	1,508	848	2,012	4,368	97	118	193	408
Massachusetts	1,594	1,237	3,343	6,174	111	192	276	580
Michigan	3,839	3,722	8,150	15,710	251	404	411	1,067
Minnesota	3,886	2,822	5,352	12,060	260	306	328	894
Mississippi	2,056	1,754	2,497	6,307	131	112	122	365
Missouri	8,287	5,659	8,138	22,085	531	456	467	1,454
Montana	1	62	220	283	0	13	28	42
Nebraska	491	484	973	1,949	33	57	73	162
Nevada	823	639	1,119	2,580	56	67	100	223
New Hampshire	254	222	774	1,251	17	33	45	95
New Jersey	2,036	1,557	3,550	7,143	132	238	328	698
New Mexico	4	105	327	436	0	22	50	72
New York	1,792	1,893	5,641	9,325	121	362	640	1,123
North Carolina	6,006	4,742	7,666	18,414	397	446	511	1,354
North Dakota	177	74	343	595	12	17	15	44
Ohio	6,492	5,657	10,720	22,869	430	610	621	1,661
Oklahoma	6,443	4,538	5,346	16,328	409	284	307	1,000
Oregon	623	658	2,084	3,365	41	102	130	273
Pennsylvania	5,132	4,441	8,594	18,167	337	507	603	1,447
Rhode Island	376	226	583	1,185	25	28	37	90
South Carolina	3,865	3,680	4,851	12,396	254	272	280	807
South Dakota	455	272	621	1,347	29	27	36	92
Tennessee	8,772	7,543	9,839	26,155	578	594	599	1,771
Texas	17,600	17,136	21,865	56,601	1,120	1,383	1,673	4,176
Utah	294	477	1,334	2,105	20	67	99	186
Vermont	307	162	400	869	21	16	24	61
Virginia	3,047	1,980	4,085	9,113	198	236	315	749
Washington	1,564	1,275	3,586	6,425	108	168	237	514
West Virginia	39	115	441	595	3	22	42	67
Wisconsin	6,867	4,031	7,747	18,646	452	409	403	1,264
Wyoming	0	35	113	148	0	8	16	24
U.S. Total	137,270	113,960	205,370	456,600	8,965	11,603	14,245	34,812

Source: Inforum

Using a concept known as location quotients⁹ allows one to calculate the specialization of a particular industry in a region. In this application, it measures the concentration of an industry's direct employment within a state relative to the overall country¹⁰. A location quotient greater than 1.0 implies the state has a higher concentration of an industry than the country as a whole.

Table 18 lists the top states as measured by employment location quotients. Some states in this table (ex: Missouri and Tennessee) were also listed in Table 16. However, location quotients highlight the importance of HVAC equipment and water heater manufacturing in other states such as Oklahoma and Arkansas. Oklahoma's value of 4.6 signifies that the state is 4.6 times more likely to have a job in the focus industry compared to the nationwide average.

Table 18: Top States Ranked by Location Quotient
Units: Location Quotient (1.0 = National Average)

Rank	State	Location Quotient
1	Oklahoma	4.6
2	Missouri	3.2
3	Tennessee	3.0
4	Arkansas	2.8
5	Wisconsin	2.5
6	Kansas	2.3
7	Mississippi	2.1
8	South Carolina	2.0
9	Iowa	1.7
10	Georgia	1.6

Source: Inforum, BLS

⁹ More information on location quotients can be found at: <https://www.bls.gov/cew/about-data/location-quotients-explained.htm>

¹⁰ Location Quotient = (Focus Industry Emp in State / Total Emp in State) / (Focus Industry Emp in USA / Total Emp in USA)

4.2 Downstream State-Level Impacts

This section highlights key takeaways for downstream state-level impacts. Recall that downstream impacts are associated with the wholesale and retail distribution of HVAC equipment and water heaters. Downstream impacts are more evenly distributed across states than direct production impacts and tend to follow the distribution of demand.

Table 19 displays the top 10 states for downstream direct output and total (direct + indirect + induced) output. The top ten states displayed here represent 54.8% of direct output and 56.1% of total output. Note that the states with the largest downstream impacts are generally those with the largest population. Texas, California, Florida, Ohio, New York, and Illinois rank highest for both direct and total output.

Table 19: Downstream Output, Top 10 States
Units: Billion \$ and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Output (Billion \$)	% Share	Rank	State	Output (Billion \$)	% Share
1	Texas	2.5	10.6%	1	Texas	7.4	11.1%
2	California	2.4	10.1%	2	California	7.1	10.6%
3	Florida	1.7	7.0%	3	Florida	4.5	6.7%
4	Ohio	1.1	4.6%	4	New York	3.1	4.7%
5	New York	1.0	4.3%	5	Illinois	3.0	4.5%
6	Illinois	1.0	4.1%	6	Ohio	2.9	4.4%
7	North Carolina	1.0	4.1%	7	North Carolina	2.5	3.8%
8	Georgia	0.8	3.5%	8	Pennsylvania	2.4	3.6%
9	Pennsylvania	0.8	3.4%	9	Georgia	2.4	3.6%
10	New Jersey	0.8	3.2%	10	New Jersey	2.1	3.2%
	All Other States	10.7	45.2%		All Other States	29.4	43.9%
	U.S. Total	23.6	100.0%		U.S. Total	66.9	100.0%

Source: Inforum

Table 20 provides downstream output and value added data for all states.

Table 20: State-Level Downstream Output and Value Added
Units: Million \$

	Output (Million \$)				Value Added (Million \$)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Alabama	268	169	317	754	161	86	174	421
Alaska	27	19	45	91	16	9	24	49
Arizona	525	332	579	1,437	316	184	341	840
Arkansas	234	133	216	583	141	69	118	327
California	2,377	1,762	2,975	7,114	1,428	946	1,688	4,062
Colorado	568	375	600	1,543	342	209	346	897
Connecticut	306	197	294	797	184	107	168	459
Delaware	54	36	65	154	32	19	35	86
Dist. of Columbia	5	22	53	80	3	11	32	45
Florida	1,658	1,058	1,789	4,505	997	586	1,040	2,623
Georgia	815	611	957	2,383	490	331	545	1,366
Hawaii	64	45	101	210	38	23	58	119
Idaho	137	71	127	335	82	38	70	191
Illinois	978	772	1,249	2,999	588	408	690	1,686
Indiana	581	349	588	1,518	349	180	316	845
Iowa	221	130	237	588	133	67	132	331
Kansas	193	135	219	547	116	70	118	304
Kentucky	269	176	308	754	162	89	166	417
Louisiana	245	168	370	783	147	79	188	415
Maine	78	47	93	217	47	25	53	125
Maryland	377	250	422	1,050	227	137	245	608
Massachusetts	506	354	587	1,447	304	193	340	837
Michigan	738	486	800	2,024	443	258	439	1,140
Minnesota	475	315	517	1,307	285	167	288	741
Mississippi	114	76	161	351	69	37	85	191
Missouri	496	341	536	1,374	298	184	301	783
Montana	78	38	78	193	47	20	42	109
Nebraska	151	95	154	400	91	49	85	225
Nevada	208	132	223	563	125	72	132	329
New Hampshire	135	75	115	326	81	42	67	190
New Jersey	750	549	811	2,111	451	300	460	1,211
New Mexico	82	47	109	238	49	24	62	135
New York	1,015	760	1,352	3,127	610	404	766	1,780
North Carolina	965	615	947	2,527	580	337	543	1,460
North Dakota	54	31	63	148	33	16	36	84
Ohio	1,076	708	1,130	2,915	647	373	616	1,635
Oklahoma	168	123	256	547	101	62	141	304
Oregon	289	188	301	778	173	102	172	448
Pennsylvania	795	596	1,037	2,428	478	313	578	1,369
Rhode Island	56	39	70	165	34	21	40	95
South Carolina	300	201	358	859	180	106	203	489
South Dakota	76	36	67	179	46	19	38	102
Tennessee	440	335	569	1,344	264	178	318	761
Texas	2,509	1,806	3,085	7,400	1,508	971	1,714	4,192
Utah	300	193	309	803	180	105	173	458
Vermont	32	17	40	90	19	9	23	51
Virginia	512	376	593	1,482	308	204	343	855
Washington	586	340	576	1,502	352	181	324	857
West Virginia	89	46	97	233	54	23	53	130
Wisconsin	632	353	546	1,532	380	190	305	875
Wyoming	18	15	40	73	11	7	21	39
U.S. Total	23,629	16,144	27,134	66,906	14,200	8,639	15,253	38,092

Source: Inforum

Table 21 displays the top ten states for direct employment and total (direct + indirect + induced) employment. The top ten states displayed here represent 54.8% of direct employment and 56.1% of total employment. Texas, California, Florida, Ohio, New York, and Illinois are the top downstream employers.

Table 21: Downstream Employment, Top 10 States
Units: Thousand Jobs and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Employment (Thousand Jobs)	% Share	Rank	State	Employment (Thousand Jobs)	% Share
1	Texas	8.9	10.6%	1	Texas	27.6	11.1%
2	California	8.5	10.1%	2	California	25.7	10.4%
3	Florida	5.9	7.0%	3	Florida	17.4	7.0%
4	Ohio	3.8	4.6%	4	Ohio	11.1	4.5%
5	New York	3.6	4.3%	5	New York	10.9	4.4%
6	Illinois	3.5	4.1%	6	Illinois	10.9	4.4%
7	North Carolina	3.4	4.1%	7	North Carolina	9.8	4.0%
8	Georgia	2.9	3.5%	8	Georgia	9.2	3.7%
9	Pennsylvania	2.8	3.4%	9	Pennsylvania	8.6	3.5%
10	New Jersey	2.7	3.2%	10	New Jersey	7.9	3.2%
	All Other States	38.1	45.2%		All Other States	108.7	43.9%
	U.S. Total	84.1	100.0%		U.S. Total	247.7	100.0%

Source: Inforum

Table 22 provides a full listing of state-level downstream impacts for employment and labor income.

Table 22: State-Level Downstream Employment and Labor Compensation
Units: Number of Jobs and Million \$

	Employment (# Jobs)				Labor Compensation (Million \$)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Alabama	955	621	1,265	2,842	69	48	86	204
Alaska	94	37	138	270	7	5	12	24
Arizona	1,871	1,344	2,145	5,360	136	102	165	402
Arkansas	834	479	918	2,231	60	38	60	159
California	8,463	5,217	12,050	25,730	613	544	840	1,996
Colorado	2,024	1,402	2,280	5,707	147	119	171	436
Connecticut	1,091	614	1,223	2,927	79	55	80	213
Delaware	191	91	240	522	14	9	13	36
Dist. of Columbia	16	3	141	160	1	7	17	26
Florida	5,905	4,643	6,860	17,408	428	332	509	1,270
Georgia	2,903	2,381	3,901	9,185	210	183	264	657
Hawaii	227	112	341	680	16	13	27	56
Idaho	489	291	529	1,309	35	21	36	92
Illinois	3,483	2,392	5,004	10,879	252	217	339	809
Indiana	2,069	1,303	2,327	5,700	150	96	159	405
Iowa	786	420	1,048	2,254	57	35	66	158
Kansas	686	408	951	2,046	50	35	53	138
Kentucky	960	580	1,279	2,818	69	46	78	194
Louisiana	871	504	1,224	2,599	63	43	88	195
Maine	277	163	357	796	20	14	28	62
Maryland	1,343	798	1,661	3,802	97	70	112	279
Massachusetts	1,803	942	2,341	5,085	131	101	163	395
Michigan	2,626	1,788	3,197	7,611	190	148	225	563
Minnesota	1,691	1,004	2,211	4,907	123	92	149	363
Mississippi	408	232	598	1,237	30	20	42	92
Missouri	1,768	1,193	2,204	5,165	128	92	138	358
Montana	277	146	303	727	20	11	21	52
Nebraska	538	310	686	1,534	39	27	43	109
Nevada	739	500	844	2,083	54	39	62	155
New Hampshire	481	250	513	1,245	35	22	30	87
New Jersey	2,672	1,668	3,550	7,890	194	151	201	545
New Mexico	293	144	391	828	21	13	31	65
New York	3,616	1,813	5,452	10,880	262	205	354	821
North Carolina	3,438	2,533	3,826	9,797	249	181	271	702
North Dakota	193	78	303	574	14	8	16	37
Ohio	3,832	2,717	4,522	11,071	278	203	314	794
Oklahoma	599	420	948	1,967	43	35	67	146
Oregon	1,028	613	1,307	2,948	74	53	84	212
Pennsylvania	2,832	1,774	3,971	8,577	205	167	290	662
Rhode Island	201	103	284	588	15	10	18	43
South Carolina	1,068	793	1,385	3,246	77	56	98	232
South Dakota	270	125	316	710	20	10	19	49
Tennessee	1,567	1,118	2,202	4,887	113	95	153	361
Texas	8,933	7,323	11,305	27,562	647	539	835	2,021
Utah	1,069	847	1,161	3,077	77	59	87	223
Vermont	114	53	154	321	8	5	11	24
Virginia	1,824	1,207	2,326	5,358	132	110	170	412
Washington	2,087	1,059	2,418	5,564	151	99	161	411
West Virginia	318	144	375	837	23	12	25	60
Wisconsin	2,251	1,331	2,409	5,991	163	102	159	425
Wyoming	65	28	125	218	5	3	9	17
U.S. Total	84,140	56,060	107,510	247,710	6,094	4,702	7,450	18,246

Source: Inforum

4.3 Combined State-Level Impacts

This portion of the report displays combined state-level impacts. These results are the sum of upstream and downstream activity presented in sections 4.1 and 4.2.

Table 23 lists the top states ranked by combined (upstream + downstream) output. The top ranked states in terms of direct output are Texas (\$8.7 billion), California (\$4.0 billion), and Tennessee (\$3.7 billion). When indirect and induced impacts are included, the largest output impacts are found in Texas, California, Ohio, Florida, and Tennessee; these five states account for roughly one-third of total (direct + indirect + induced) output.

Table 23: Combined (Upstream + Downstream) Output, Top 10 States
Units: Billion \$ and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Output (Billion \$)	% Share	Rank	State	Output (Billion \$)	% Share
1	Texas	8.7	12.1%	1	Texas	25.2	11.9%
2	California	4.0	5.5%	2	California	15.4	7.3%
3	Tennessee	3.7	5.1%	3	Ohio	10.0	4.7%
4	Missouri	3.4	4.8%	4	Florida	10.0	4.7%
5	Ohio	3.4	4.7%	5	Tennessee	9.5	4.5%
6	Georgia	3.3	4.6%	6	Georgia	8.9	4.2%
7	Florida	3.3	4.5%	7	Illinois	8.7	4.1%
8	North Carolina	3.0	4.2%	8	Pennsylvania	8.4	4.0%
9	Wisconsin	2.9	4.0%	9	Missouri	8.2	3.9%
10	Pennsylvania	2.6	3.7%	10	North Carolina	8.1	3.8%
	All Other States	33.8	46.9%		All Other States	99.1	46.9%
	U.S. Total	72.1	100.0%		U.S. Total	211.3	100.0%

Source: Inforum

Table 24 displays combined (upstream + downstream) output and value added data for all states.

Table 24: State-Level Combined (Upstream + Downstream) Output and Value Added
Units: Million \$

	Output (Million \$)				Value Added (Million \$)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Alabama	1,038	957	1,028	3,023	444	406	567	1,417
Alaska	30	40	125	195	17	15	67	99
Arizona	923	728	1,391	3,042	448	366	818	1,633
Arkansas	1,353	966	810	3,129	505	480	444	1,430
California	3,987	3,999	7,393	15,379	1,971	1,879	4,196	8,047
Colorado	972	757	1,364	3,092	473	392	786	1,651
Connecticut	504	491	735	1,730	264	217	416	897
Delaware	70	73	177	321	37	33	97	167
Dist. of Columbia	5	43	165	212	3	18	99	120
Florida	3,272	2,344	4,380	9,997	1,525	1,235	2,538	5,298
Georgia	3,287	2,581	3,011	8,879	1,311	1,324	1,725	4,359
Hawaii	64	82	261	407	38	34	151	223
Idaho	240	167	312	720	117	83	172	372
Illinois	2,589	2,613	3,450	8,653	1,153	1,214	1,909	4,276
Indiana	2,119	2,034	1,891	6,044	857	901	1,016	2,773
Iowa	1,125	871	829	2,825	434	423	464	1,322
Kansas	1,222	879	836	2,938	455	456	455	1,366
Kentucky	987	937	988	2,912	422	388	534	1,344
Louisiana	620	520	1,063	2,203	270	225	535	1,031
Maine	131	115	241	487	65	53	137	255
Maryland	911	607	1,134	2,651	399	326	659	1,384
Massachusetts	1,074	916	1,572	3,563	508	458	909	1,875
Michigan	2,141	2,153	2,311	6,605	945	931	1,266	3,141
Minnesota	1,868	1,459	1,661	4,988	756	759	932	2,447
Mississippi	871	634	616	2,121	319	298	331	948
Missouri	3,440	2,526	2,259	8,224	1,262	1,327	1,281	3,870
Montana	78	71	190	339	47	29	102	178
Nebraska	324	267	418	1,009	150	125	229	504
Nevada	504	303	600	1,407	244	152	353	749
New Hampshire	216	185	283	684	109	90	163	362
New Jersey	1,455	1,275	2,030	4,760	680	641	1,149	2,470
New Mexico	84	95	287	466	50	39	164	253
New York	1,612	1,657	3,625	6,894	811	770	2,054	3,635
North Carolina	3,008	2,353	2,747	8,108	1,292	1,176	1,579	4,046
North Dakota	118	71	164	353	53	29	74	156
Ohio	3,368	3,253	3,389	10,010	1,442	1,480	1,851	4,774
Oklahoma	2,472	1,372	1,329	5,173	841	783	745	2,368
Oregon	514	495	764	1,773	248	235	435	918
Pennsylvania	2,639	2,552	3,170	8,361	1,118	1,187	1,777	4,083
Rhode Island	192	141	209	541	78	73	121	272
South Carolina	1,766	1,436	1,364	4,567	700	671	778	2,149
South Dakota	241	133	197	571	99	72	110	281
Tennessee	3,704	3,052	2,700	9,456	1,402	1,505	1,527	4,434
Texas	8,697	7,213	9,266	25,176	3,494	3,666	5,157	12,316
Utah	399	387	679	1,465	218	178	377	772
Vermont	141	75	129	345	56	40	74	170
Virginia	1,585	1,181	1,695	4,461	656	617	985	2,258
Washington	1,140	886	1,465	3,491	539	419	820	1,778
West Virginia	103	111	256	471	58	44	139	241
Wisconsin	2,862	2,112	1,941	6,914	1,156	1,052	1,090	3,298
Wyoming	18	37	114	169	11	12	59	82
U.S. Total	72,085	60,208	79,015	211,307	30,551	29,325	44,419	104,295

Source: Inforum

Table 25 highlights the top states ranked by combined (upstream + downstream) employment. Texas ranks highest in terms of direct employment with 26.5 thousand jobs. The next five states (California, Florida, Tennessee, Ohio, and Missouri), meanwhile, all exceed 10 thousand jobs related to the manufacture and distribution of HVACR equipment and water heaters. When indirect and induced jobs are included, the top states as measured by employment are Texas (84.2 thousand), California (50.1 thousand), and Ohio (33.9 thousand).

Table 25: Combined (Upstream + Downstream) Employment, Top 10 States
Units: Thousand Jobs and Share of Total

Direct				Total (Direct + Indirect + Induced)			
Rank	State	Employment (Thousand Jobs)	% Share	Rank	State	Employment (Thousand Jobs)	% Share
1	Texas	26.5	12.0%	1	Texas	84.2	11.9%
2	California	13.2	5.9%	2	California	50.1	7.1%
3	Florida	10.6	4.8%	3	Ohio	33.9	4.8%
4	Tennessee	10.3	4.7%	4	Florida	33.0	4.7%
5	Ohio	10.3	4.7%	5	Tennessee	31.0	4.4%
6	Missouri	10.1	4.5%	6	Georgia	29.5	4.2%
7	Georgia	9.7	4.4%	7	North Carolina	28.2	4.0%
8	North Carolina	9.4	4.3%	8	Illinois	27.6	3.9%
9	Wisconsin	9.1	4.1%	9	Missouri	27.2	3.9%
10	Illinois	8.2	3.7%	10	Pennsylvania	26.7	3.8%
	All Other States	104.0	47.0%		All Other States	332.8	47.2%
	U.S. Total	221.4	100.0%		U.S. Total	704.3	100.0%

Source: Inforum

Table 26 provides a full listing of state-level combined (upstream + downstream) impacts for employment and labor income.

Table 26: State-Level Combined (Upstream + Downstream) Employment and Labor Compensation

Units: Number of Jobs and Million \$

	Employment (# Jobs)				Labor Compensation (Million \$)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Alabama	3,142	2,988	4,856	10,986	219	224	279	722
Alaska	103	81	243	427	8	14	32	54
Arizona	3,003	2,554	4,712	10,269	209	236	387	832
Arkansas	3,968	2,953	4,081	11,002	260	216	228	704
California	13,156	9,990	26,931	50,076	926	1,359	2,056	4,342
Colorado	3,221	2,332	4,529	10,083	224	257	379	861
Connecticut	1,674	1,180	3,152	6,006	120	143	200	463
Delaware	236	169	471	876	17	25	44	86
Dist. of Columbia	16	68	262	347	1	22	56	79
Florida	10,621	8,229	14,166	33,017	734	775	1,223	2,733
Georgia	9,666	7,837	12,018	29,522	643	699	836	2,178
Hawaii	227	201	545	972	16	32	69	117
Idaho	779	567	1,224	2,570	55	54	86	195
Illinois	8,163	6,085	13,335	27,583	563	710	932	2,205
Indiana	6,586	4,777	9,799	21,162	445	443	504	1,392
Iowa	3,250	2,457	4,316	10,023	218	200	231	648
Kansas	3,550	2,710	4,123	10,383	237	193	214	644
Kentucky	3,151	2,058	4,668	9,877	215	205	254	674
Louisiana	1,901	1,341	2,980	6,222	130	140	246	516
Maine	422	344	861	1,627	30	40	70	139
Maryland	2,850	1,645	3,674	8,169	195	189	305	688
Massachusetts	3,397	2,178	5,684	11,259	242	294	439	975
Michigan	6,465	5,510	11,347	23,321	442	552	636	1,629
Minnesota	5,578	3,826	7,563	16,967	383	398	476	1,257
Mississippi	2,463	1,986	3,096	7,545	160	132	164	456
Missouri	10,055	6,853	10,342	27,250	659	548	605	1,812
Montana	278	208	523	1,010	20	24	49	94
Nebraska	1,030	795	1,659	3,484	72	83	116	271
Nevada	1,562	1,139	1,962	4,663	110	106	162	377
New Hampshire	735	473	1,287	2,495	52	55	76	182
New Jersey	4,708	3,225	7,100	15,033	325	389	529	1,243
New Mexico	297	248	718	1,263	22	36	81	138
New York	5,407	3,705	11,093	20,206	383	566	995	1,943
North Carolina	9,444	7,274	11,493	28,211	646	627	782	2,055
North Dakota	370	152	646	1,169	26	25	31	81
Ohio	10,324	8,373	15,243	33,940	708	812	935	2,455
Oklahoma	7,042	4,959	6,294	18,294	452	319	375	1,146
Oregon	1,651	1,272	3,391	6,314	115	155	215	485
Pennsylvania	7,964	6,215	12,565	26,744	542	674	893	2,110
Rhode Island	577	329	867	1,773	39	39	55	133
South Carolina	4,933	4,473	6,236	15,642	332	328	379	1,038
South Dakota	725	397	936	2,058	49	37	55	141
Tennessee	10,339	8,661	12,041	31,042	691	689	752	2,132
Texas	26,533	24,459	33,170	84,163	1,767	1,922	2,508	6,197
Utah	1,363	1,324	2,495	5,182	98	126	185	409
Vermont	420	215	554	1,189	30	21	35	85
Virginia	4,871	3,188	6,411	14,470	330	346	485	1,161
Washington	3,651	2,334	6,005	11,989	259	267	398	925
West Virginia	357	258	816	1,431	26	34	67	127
Wisconsin	9,118	5,363	10,157	24,637	615	512	562	1,689
Wyoming	65	63	238	367	5	11	25	41
U.S. Total	221,410	170,020	312,880	704,310	15,059	16,304	21,695	53,059

Source: Inforum

5. Conclusion

This study began by defining the HVACR equipment and water heater manufacturing industry using relevant shares of published data. With the estimated scope established, recent trends were described.

HVACR equipment and water heater manufacturing directly accounted for 137.3 thousand jobs and \$48.5 billion in output in 2021. This economic contribution does not exist in isolation, however. Manufacturers support upstream industries through the purchases of goods, services, and energy. These indirect impacts generate an additional 114.0 thousand jobs and \$44.1 billion in output. Finally, induced impacts (spending of earnings by direct and indirect employees) contributed a further 205.4 thousand jobs and \$51.9 billion in output. Together, this totals 456.6 thousand jobs and \$144.4 billion in output.

The downstream analysis focuses on the economic activity associated with the distribution of HVACR equipment and water heaters through wholesale and retail outlets. This portion of the study uses the margin or markup earned on sales as the direct impact. It was estimated to be \$23.6 billion in 2021, which supported 84,100 direct jobs. The downstream activity has its own indirect and induced impacts. When these are included, total downstream activity approaches \$67 billion in output and 248 thousand jobs.

Combining the upstream and downstream impacts results in a total output impact of \$211.3 billion and 704.4 thousand jobs.

Table 27: Combined (Upstream and Downstream) Impact Summary
Units: Thousand Jobs and Billion \$

	Employment (Thousand Jobs)	Labor Income (Billion \$)	Value Added (Billion \$)	Output (Billion \$)
Upstream	456.6	34.8	66.2	144.4
Downstream	247.7	18.2	38.1	66.9
Total	704.4	53.1	104.3	211.3

Source: Inforum

The state-level analysis was performed using a combination of the BEA RIMS model and the Inforum national and state-level models and databases. The BLS Quarterly 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. Manufacturing and other upstream impacts tends to be concentrated in a relatively small number of regions; the top three states as measured by output (Texas, Tennessee, and Missouri) account for more than a quarter of national activity. Using employment data and location quotients helps to highlight other states where the industry plays an outsized role in the regional economy. In particular, Oklahoma and Arkansas both had a high concentration of HVACR equipment and water heater manufacturing jobs compared to the national average.

Downstream impacts, which measure wholesale and retail activity, tend to be heavily correlated with population. Texas, California, and Florida make up the top three states measured by total (direct + indirect + induced) output and employment.

While the impacts described in this report are significant, other related industries also support jobs and output. Appendix B highlights two such related industries (Plumbing and HVAC Contractors; Automatic Environmental Control Manufacturing) and summarizes available data.

In summary, HVACR equipment and water heater manufacturers make significant contributions to the national economy; their impact is especially important to certain states where activity is concentrated.

Appendix A. Shares of Industries Included in Analysis

The following tables list specific products included to calculate the industry shares used in this analysis. These products reflect detailed data published in the Census Bureau's 2017 Economic Census. In some cases, similar 2012 Economic Census information was utilized.

Table A-1: Share of NAICS 333413 - Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing

333413 - Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing	72.0%
Manufacturing of air and gas compressors (excluding compressors for ice making, refrigeration, and air-conditioning equipment), including air motors and packaged compressors	X
Manufacturing of other centrifugal fans and blowers, excluding parts	X
Manufacturing of axial fans, excluding parts	X
Manufacturing of industrial propeller fans, excluding parts	X
Manufacturing of dust collection and other air purification equipment for industrial gas cleaning systems (for cleaning outgoing air), excluding parts	
Manufacturing of other dust collection and air purification equipment, excluding parts	X
Manufacturing of weldments and fabricated steel plate for other purposes, other than for construction and mining	
Manufacturing of sheet metal roof ventilators, louvers, and dampers for heating, ventilation, and air conditioning	X
Manufacturing of power roof ventilators and parts	X
Manufacturing of centrifugal blower-filter units, and classes I-IV centrifugal fans, excluding	X
Manufacturing of evaporative air coolers	X
Manufacturing of air filters for air conditioners and furnaces, etc., of 2400 CFM or less,	
Manufacturing of parts for dust collection and air purification equipment	X
Manufacturing of parts for industrial air purification equipment	X
Manufacturing of penthouses, shutters, guards, and other parts and accessories for industrial centrifugal, axial, and propeller fans and blowers (excluding power roof	X
Machinery contract manufacturing services	
Other manufacturing revenue, not elsewhere classified	

Source: Inforum calculations using 2017 and 2012 Economic Census information

Table A-2: Share of NAICS 333414 - Heating Equipment (except Warm Air Furnaces) Manufacturing

333414 - Heating Equipment (except Warm Air Furnaces) Manufacturing	98.6%
Manufacturing of domestic heating stoves, hearth appliances, and freestanding wood fireplaces (excluding electric and parts)	X
Manufacturing of pressure tanks, including liquefied petroleum gas and air receivers, ferrous and nonferrous metal (standard line pressure)	
Manufacturing of cast iron, aluminum, and other nonferrous metal types of boilers, radiators, and convectors, including baseboard, finned tube, residential, and special types (excluding electric, automotive, and parts)	X
Manufacturing of steel heating boilers (15 psi or less), and all other hot water heating boilers (excluding parts)	X
Manufacturing of floor and wall furnaces, unit heaters, gas-fired infrared heaters, and mechanical stokers	X
Manufacturing of other heating system products, excluding industrial types (including parts for nonelectric heating equipment and oil burners)	X
Manufacturing of all other structural clay products (architectural terra cotta, drain tile, flue tile, roofing tile, conduit, etc.), excluding clay refractories	
Machinery contract manufacturing services	
Other electronic and electrical contract manufacturing services	
Other manufacturing revenue, not elsewhere classified	

Source: Inforum calculations using 2017 and 2012 Economic Census information

Table A-3: Share of NAICS 333415 - Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing

333415 - Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	96.3%
Manufacturing of household refrigerators, including combination refrigerator-freezers	
Manufacturing of room air conditioners and dehumidifiers, excluding portable dehumidifiers	
Manufacturing of foundry machinery and equipment, excluding patterns and molds	
Manufacturing of all other miscellaneous special industry machinery	
Manufacturing of switchgear, excluding ducts and relays	X
Manufacturing of commercial refrigerators and related equipment	X
Manufacturing of all other miscellaneous refrigeration equipment	X
Manufacturing of heat transfer equipment (excluding electrically operated dehumidifiers), mechanically refrigerated, self-contained, excluding motor vehicle mechanical air-conditioning systems	X
Manufacturing of other service industry equipment	
Manufacturing of warm air furnaces, including duct furnaces and humidifiers, and electric comfort heating	X
Manufacturing of parts for warm air furnaces, including duct furnaces (excluding complete humidifiers)	X
Manufacturing of other heating system products, excluding industrial types (including parts for nonelectric heating equipment and oil burners)	X
Manufacturing of unitary air conditioners, excluding air source heat pumps	X
Manufacturing of air-source heat pumps, excluding room air conditioners	X
Manufacturing of ground- and ground-water-source heat pumps	X
Manufacturing of refrigeration condensing units, all refrigerants, excluding ammonia (complete)	X
Manufacturing of evaporative air coolers	X
Manufacturing of compressors and compressor units, all refrigerants, excluding automobiles	X
Manufacturing of parts for air conditioners, heat pumps, and other cooling equipment	X
Manufacturing of all other miscellaneous parts for refrigeration and air-conditioning equipment	X
Manufacturing of gasoline engine parts for motor vehicles, new	
Manufacturing of parts and accessories for internal combustion engines, excluding aircraft and gas automotive engines and turbines	
Manufacturing of parts and accessories for railroads, streetcars, truck assemblies, railway maintenance of railway way equipment, etc., including brake equipment	
Manufacturing of other parts for farm machinery (excluding for wheel tractors), including operator cabs, for sale separately	
Manufacturing of parts for metal forming machine tools	
Manufacturing of parts and attachments for pumps and pumping equipment, excluding for hydraulic fluid power, and air and gas compressors (including packaged pumps)	
Manufacturing of all other parts and attachments for service industry equipment (including parts for water softeners) (excluding tanks), floor and carpet cleaning equipment, and dishwashing machines	
Manufacturing of parts for dehumidifiers and room air conditioners	
Machine shop job work and job order repairs	
Other manufacturing revenue, not elsewhere classified	

Source: Inforum calculations using 2017 and 2012 Economic Census information

Table A-4: Share of NAICS 335220 - Major Household Appliance Manufacturing

335220 - Major Household Appliance Manufacturing	12.0%
Manufacturing of household refrigerators, including combination refrigerator-freezers	
Manufacturing of household food freezers, complete units	
Manufacturing of household laundry machines, including both coin- and non-coin operated washing machines, dryers, and combinations	
Manufacturing of dishwashers and other miscellaneous major household appliances (including food waste disposers and trash compactors, etc.)	
Manufacturing of outdoor cooking equipment and supplies	
Manufacturing of household water heaters, electric, for permanent installation	X
Manufacturing of household water heaters, excluding electric	X
Manufacturing of parts and attachments for household refrigerators and freezers,	
Manufacturing of parts and accessories for outdoor and other portable cooking	
Manufacturing of parts and accessories for household electric ranges and ovens (including burners, rotisseries, oven racks, broiler pans, etc.)	
Manufacturing of parts and accessories for gas household ranges and ovens (including burners, rotisseries, oven racks, broiler pans, etc.)	
Manufacturing of parts and accessories for dishwashers and other miscellaneous major household appliances (including food waste disposers and trash compactors, etc.)	
Other manufacturing revenue, not elsewhere classified	

Source: Inforum calculations using 2017 and 2012 Economic Census information

Appendix B. Related Economic Activity

This report focused on the impacts associated with HVACR equipment and water heater manufacturing. However, the related activity described below also makes contributions to the economy.

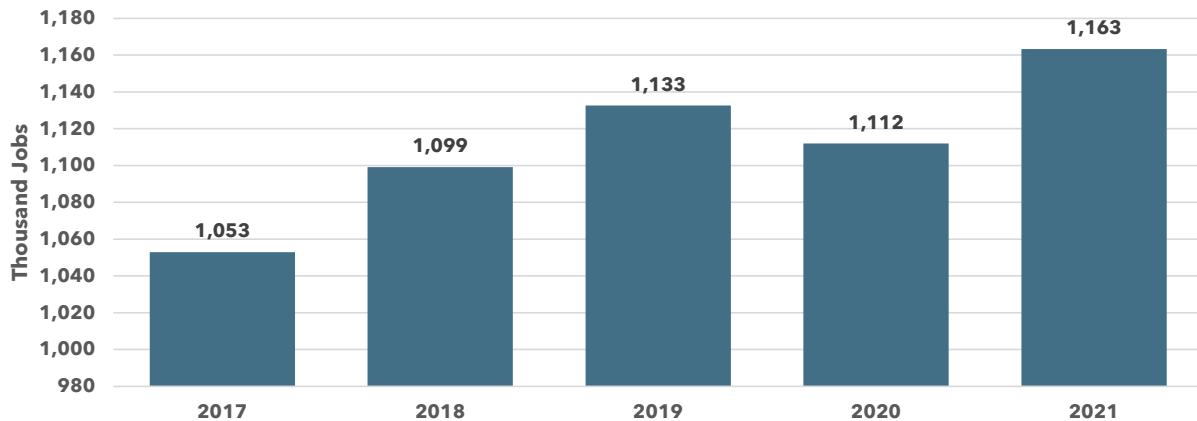
Plumbing and HVAC Contractors

Contractors often are hired to install and maintain HVACR equipment and water heaters. Data limitations prevent this category from being included in the contribution analysis (direct, indirect, induced calculations) portion of the report, but they should not be omitted altogether.

Bureau of Labor Statistics report employment data for NAICS 238220 (Plumbing and HVAC Contractors). However, insufficient detail is available to allocate a specific share to HVACR equipment and water heater-related activity.

Table B-1 shows recent employment figures for the overall plumbing and HVAC contractor industry. Employment levels increased between 2017 and 2019, but declined by about 20.5 thousand during the first year of the pandemic in 2020. The upward trend resumed in 2021 and industry employment approached a level of 1.2 million.

Figure B-1: Plumbing and HVAC Contractor Employment
Units: Thousand Jobs



Source: Bureau of Labor Statistics

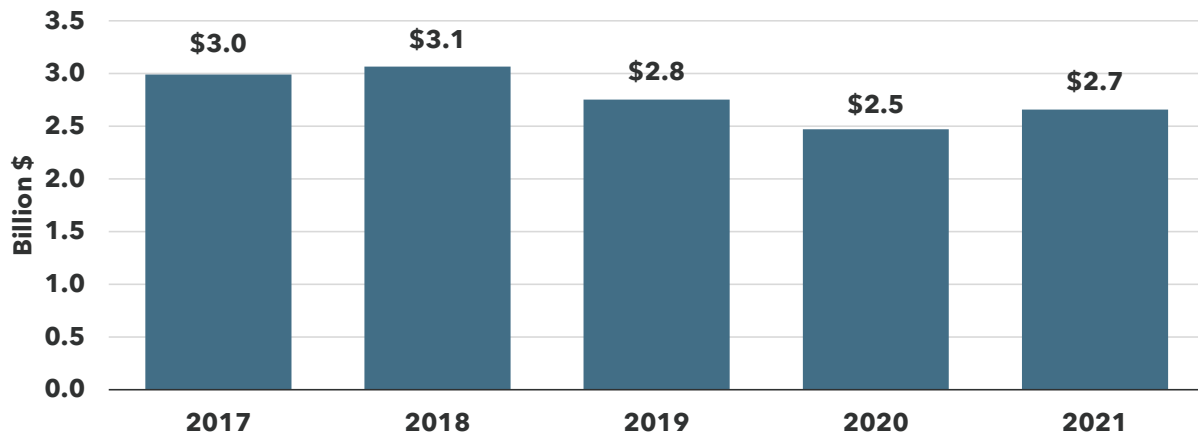
Automatic Environmental Control Manufacturing

The Automatic Environmental Control Manufacturing industry (NAICS 334512) produces equipment which monitor and control systems, including HVAC equipment and water heaters. However, the limited detail of government-produced statistics makes it difficult to parse out activity specifically relevant to AHRI stakeholders. Importantly, a portion of this activity might already be captured in the upstream indirect results described in Section 3.2.

The Census Bureau's ASM data below represents the entire Automatic Environmental Control Manufacturing industry. Figure B-2 shows that industry sales declined from \$3.1 billion in 2018 to \$2.5 billion in 2020 before growing mildly to \$2.7 billion in 2021. Figure B-3 displays how the industry's employment declined each year between 2017 and 2021, slipping most recently to 9.3 thousand jobs in 2021.

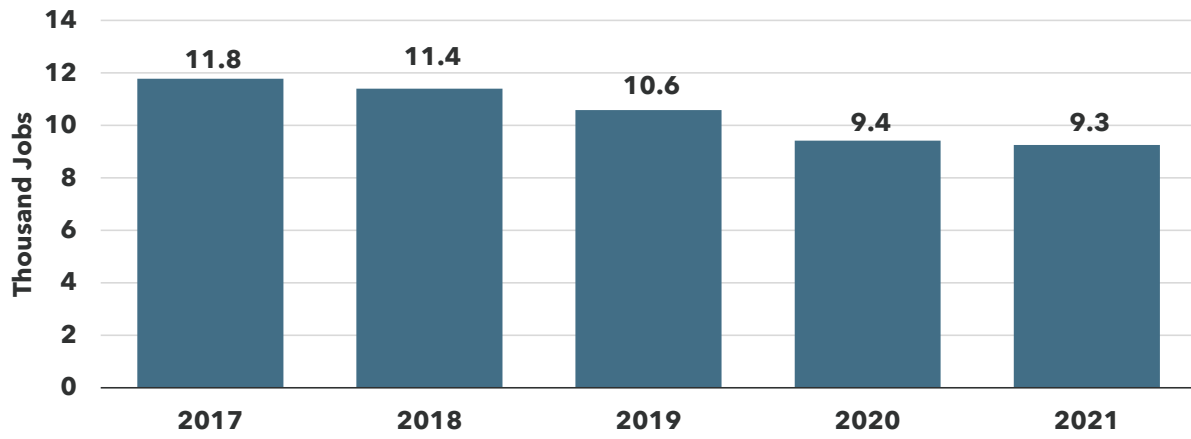
Figure B-2: Automatic Environmental Control Manufacturing Sales

Units: Billion \$



Source: Census Bureau

Figure B-3: Automatic Environmental Control Manufacturing Employment
Units: Thousand Jobs



Source: Census Bureau

Appendix C. Methodology Notes

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 350 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 2021. 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.

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), 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. 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 2012 Benchmark Input-Output table produced by the Bureau of Economic Analysis (BEA). 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 372 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 372 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 these industries is provided for each state. Table C-1 shows the 21 industries and their NAICS definitions.

Table C-1 Aggregate Industry Level of RIMS Multipliers

#	Description	NAICS Code
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 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.

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. The total out-of-state purchases by the 21 industries listed above were first calculated by aggregating the national indirects from 350 to 21 sectors, and subtracting from this the total of all in-state indirects calculated using RIMS. These indirects were then distributed to states according to the national share of production of each industry in that state. The procedure for distributing out-of-state induced expenditures was analogous.