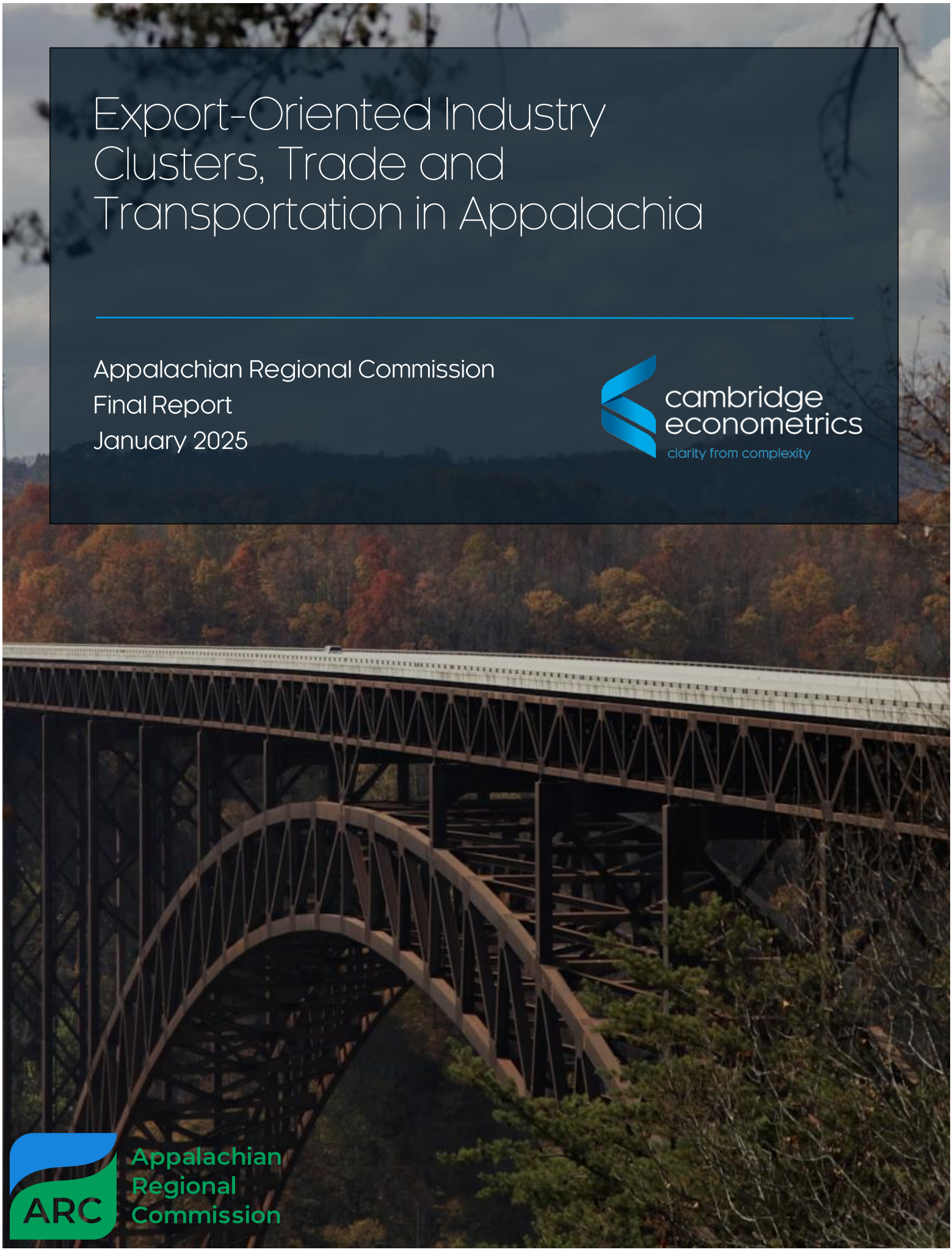

Export-Oriented Industry Clusters, Trade and Transportation in Appalachia

Appalachian Regional Commission
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cambridge econometrics
clarity from complexity

Appalachian Regional Commission

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1. Background & Study Purpose

A comprehensive assessment of industry clusters in Appalachia has not been completed since 2004, when the Appalachian Regional Commission published a report titled “Analysis of Global Competitiveness of Selected Industries and Clusters in the Appalachian Region.” This report analyzed and provided insight into six export-oriented industry clusters: auto parts, electronic components, wooden household furniture, upholstered household furniture, food processing machinery, and packaging machinery.

About 20 years later, this report provides a current analysis of key export-oriented industries and industry clusters, reflecting the evolving industrial landscape of Appalachia and the global economy these industries serve. This analysis identifies seven key export-oriented industry clusters in the Appalachian Region: (1) chemicals and plastics; (2) consumer products; (3) electronics; (4) machinery; (5) metals and minerals; (6) mining; and (7) transportation equipment and vehicles.

This report builds upon previous research of industry clusters in Appalachia to identify and assess the economic characteristics of *export-oriented* industry clusters – i.e., industry groups for which international exports make up a substantial portion of total sales. Through analysis of these export-oriented industry clusters, this analysis seeks to provide insight into important trends, including:

- The evolving economic characteristics of Appalachia’s export-oriented industries
- The multi-modal transportation needs of Appalachian industry, and how these needs relate to evolving transportation infrastructure and services
- The broader freight industry trends in Appalachia, such as the decline in rail transportation of coal and the increase in warehousing and distribution

Increased understanding of these industry clusters – such as areas of specialization and infrastructure needs – can help policymakers develop effective strategic economic development plans for the region.

The remainder of this report is organized as follows:

- Chapter 2 identifies and assesses the economic characteristics of key export-oriented industry clusters.
- Chapter 3 discusses the contribution transportation services – from both export-oriented and other industries – make to the Appalachian economy.
- Chapter 4 discusses key freight industry trends in Appalachia, including the decline in coal shipments and the increase in warehousing and distribution activities.
- Chapter 5 provides a summary of findings.

2. Export-Oriented Industry Clusters

Industry cluster analysis helps identify key sectors and growth opportunities within an economy. By examining clusters of related industries, policymakers and economic development professionals can pinpoint areas of strength and specialization and identify potential supply-chain bottlenecks. Understanding these clusters enables targeted investments and strategic planning in the region. A comprehensive assessment of industry clusters in Appalachia has not been completed since 2004.[1] The 2004 analysis focused on regional manufacturing industries and identified six export-oriented industry clusters: auto parts, electronic components, wooden household furniture, upholstered household furniture, food processing machinery, and packaging machinery.[2] About 20 years later, this report provides a fresh analysis of key industries and industry clusters that export internationally from the region.

This updated analysis identifies seven export-oriented industry clusters in the Appalachian Region: chemicals and plastics; consumer products; electronics; machinery; metals and minerals; mining; and transportation. Each cluster comprises a group of industries selected based on having both (1) substantial overall employment, and (2) significant export activity.

While the specific definitions vary across the reports (the 2004 report uses 4-digit Standard Industrial Classification (SIC) rather than 3- or 4-digit North American Industrial Classification System (NAICS) codes), several cluster groupings identified in the updated analysis overlap with the clusters highlighted over two decades ago. These overlapping clusters include electronics, motor vehicle parts (which is included under the transportation cluster), and machinery. These clusters have a long-standing presence in the region and continue to be cornerstones of the regional economy. At the same time, several new clusters have emerged in this updated analysis, including chemicals and plastics, consumer products, and metals and minerals, whereas other clusters from the 2004 report, such as textiles, wood, and furniture manufacturing, do not meet the new criteria. This section describes the methodology used to identify this updated set of clusters and explains why some industries of regional importance are not included in this export-focused analysis.

[1] Jack Faucett Associates and Economic Development Research Group, 2004. Analysis of Global Competitiveness of Selected Industries and Clusters in the Appalachian Region. https://www.arc.gov/report/analysis-of-global-competitiveness-of-selected-industries-and-clusters-in-the-appalachian-region/.

[2] The 2004 report also included analysis of service sectors such as education. In contrast, this analysis focuses on exports of commodities.

2.1. Methodology & Cluster Identification

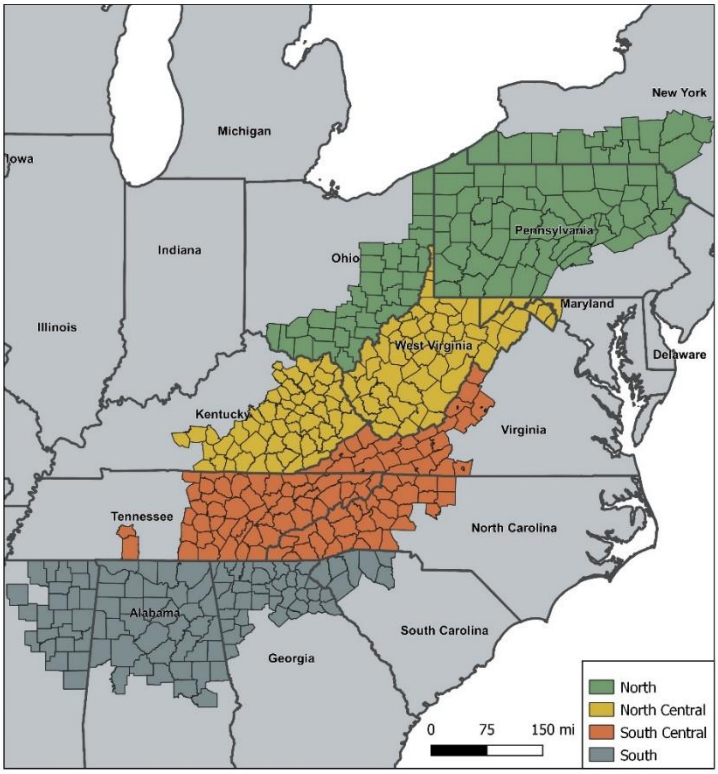
2.1.1 Methodology

The analysis to identify export-oriented industry clusters consists of three steps, illustrated in Figure 2.1.2:

1. **Identify Potential Export Industries:** This study focused on industries that are associated with commodities that are exported from the region. The pool consists of 42 industries defined by three- or four-digit NAICS codes and is mainly comprised of manufacturing and wholesale industries.[3]

2. **Evaluate Industries against Criteria:** To focus the analysis on a smaller group of industries, this step evaluates the 42 industries against a set of criteria. As shown in Figure 2.1.2, the filtering criteria aim to capture industries that are of substantial size (in terms of employment) and are export-oriented (either in terms of foreign export share of total output or total value of foreign exports). This step is completed for the Appalachian Region as a whole and each of its four subregions (shown in Figure 2.1.1) individually.

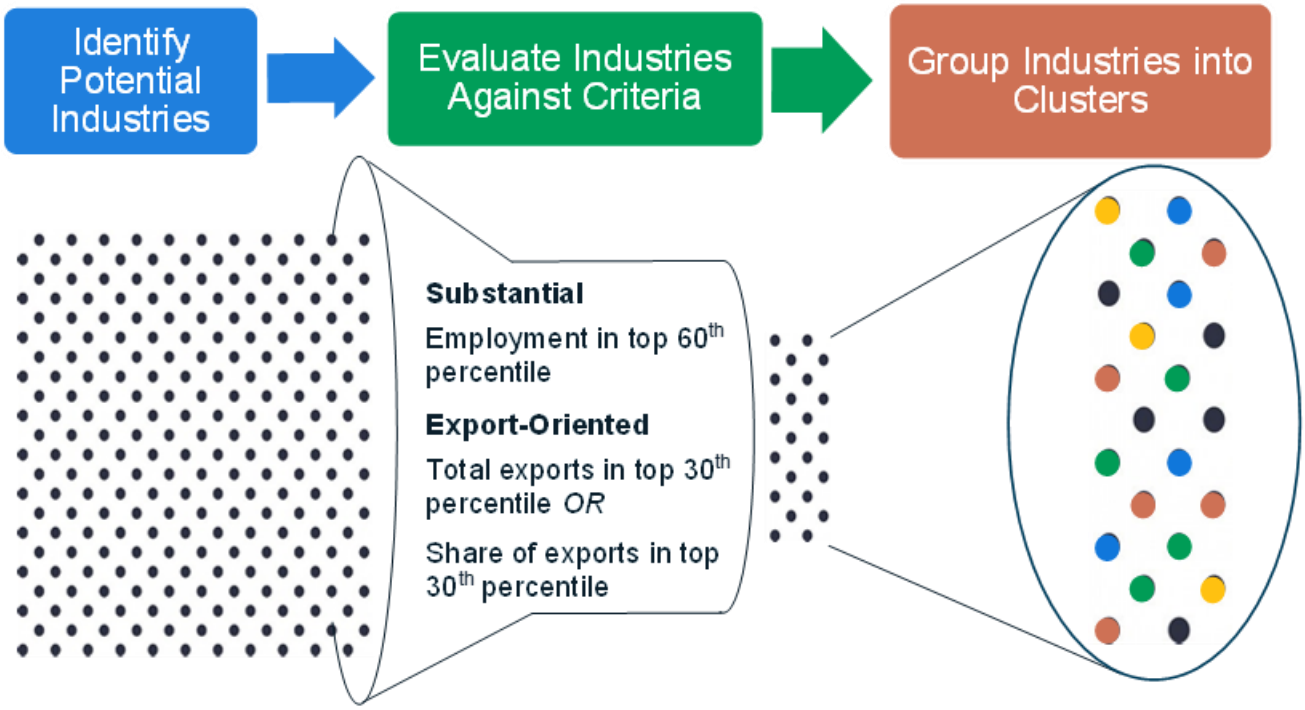
Figure 2.1.1 Appalachia Subregions Map



3. **Group Industries into Clusters:** In this qualitative step, the selected industries are grouped together to form industry clusters that are focused on a similar set of activities or goods.

[3] For more information about the industries included, see the Appendix.

Figure 2.1.2 Cluster Identification Methodology



Note: The filtering criteria thresholds are based on natural breaks in the data and professional judgement.

This analysis relies on employment data by county and 4-digit NAICS code from Mass Economics' data-Fab.[4] Importantly, these data fill in missing data fields (which are common at the county level) to provide reliable, comprehensive employment and wage estimates at the county level.

Freight Analysis Framework (FAF) data from the BTS are used to estimate freight flows exported from Appalachia. These publicly available data provide freight flows for FAF regions, which are clusters of counties. The time series spans 2017 to 2022 and the data are available for each origin-destination pair, allowing for analysis of imports and exports as well as domestic freight flows.

While FAF data offer a detailed and well-vetted source for freight flow information, two issues arise. First, the FAF regions do not align with the Appalachian Region boundaries. To overcome this challenge, we follow the

[4] These data are based on the BLS Quarterly Census of Employment and Wages, but employment and wages in small areas are estimated using a sophisticated methodology that combines multiple data sources and data estimation techniques. This approach fills in missing data fields to provide reliable, state-of-the-art employment and wage estimates at the county level. ARC purchased this data for employment and wage data at the 4-digit NAICS level. For more information, visit https://masseconomics.com/data-fab/.

methodology outlined in the 2023 Network Appalachia report,[5] to estimate the freight activity occurring in the region. For each FAF region (which are aligned with state geographies), we estimate the share of freight activity that occurs within Appalachia and apply that share to the FAF5 freight data estimates. For inbound transactions, where demand is largely driven by population, we use the share of the population living in the Appalachian portion of the region. Alternatively, we use the percentage of employment in freight related industries as a proxy for the share of outbound freight from Appalachian counties.

Second, the FAF data include freight flows by commodity but do not provide information about the industrial classification of enterprises. Since the clusters are defined by NAICS industry, mapping commodities to industries was a necessary step. The BTS Commodity Flow Survey (CFS) provides a bridge between commodities and industries. The survey shows shipments both by commodity and NAICS industry at the three- or four-digit level. We calculate the share of a commodity's shipment value associated with each NAICS industry. We then apply this share to the FAF commodity-level data to map shipments to industries.[6]

More detail about each step and the corresponding data and limitations is provided in the Appendix.

2.1.2 Clusters Overview

This analysis identifies seven distinct export-oriented industry clusters operating in the Appalachia Region, as shown in Figure 2.1.3. These clusters include 19 industries, as defined by the NAICS that make up about 15 percent of the region's overall employment and 85 percent of foreign exports.

[5] Cambridge Econometrics, 2023. Network Appalachia: Freight, Trade, and Economic Development. https://www.arc.gov/report/network-appalachia-freight-trade-and-economic-development/.

[6] The most recent CFS available at the time of this report was from 2017. As such, 2017 NAICS codes had to be mapped to 2022 classifications. As part of this process, the electronic shopping and mail-order houses sector was dropped. Prior to calculating NAICS shares for each commodity, two sectors were dropped because they are related to logistics and management rather than the commodities themselves: warehousing and storage and management of companies and enterprises.

Figure 2.1.3 Industries Included in Each Cluster

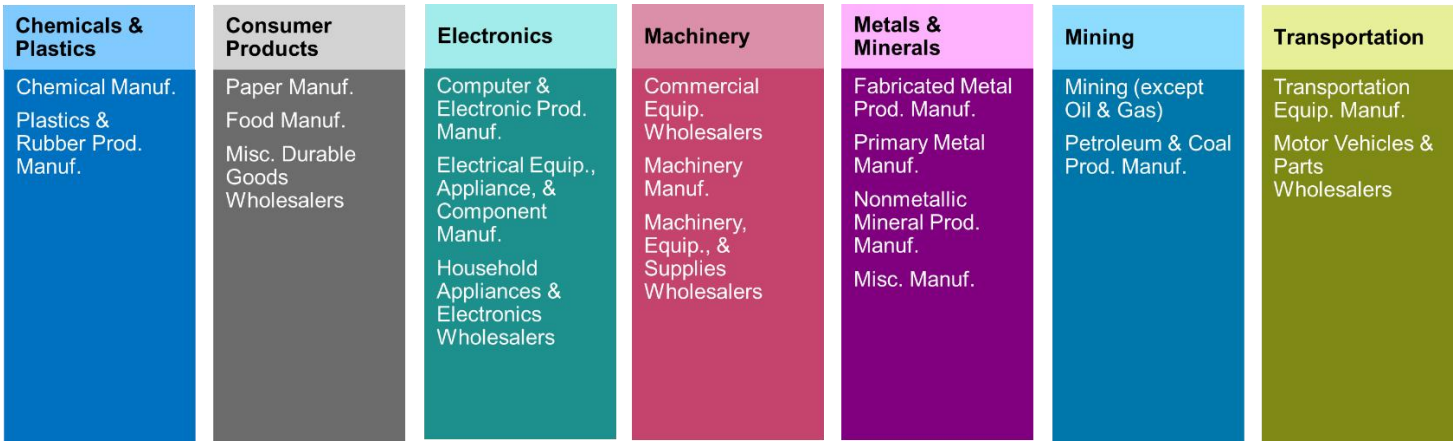
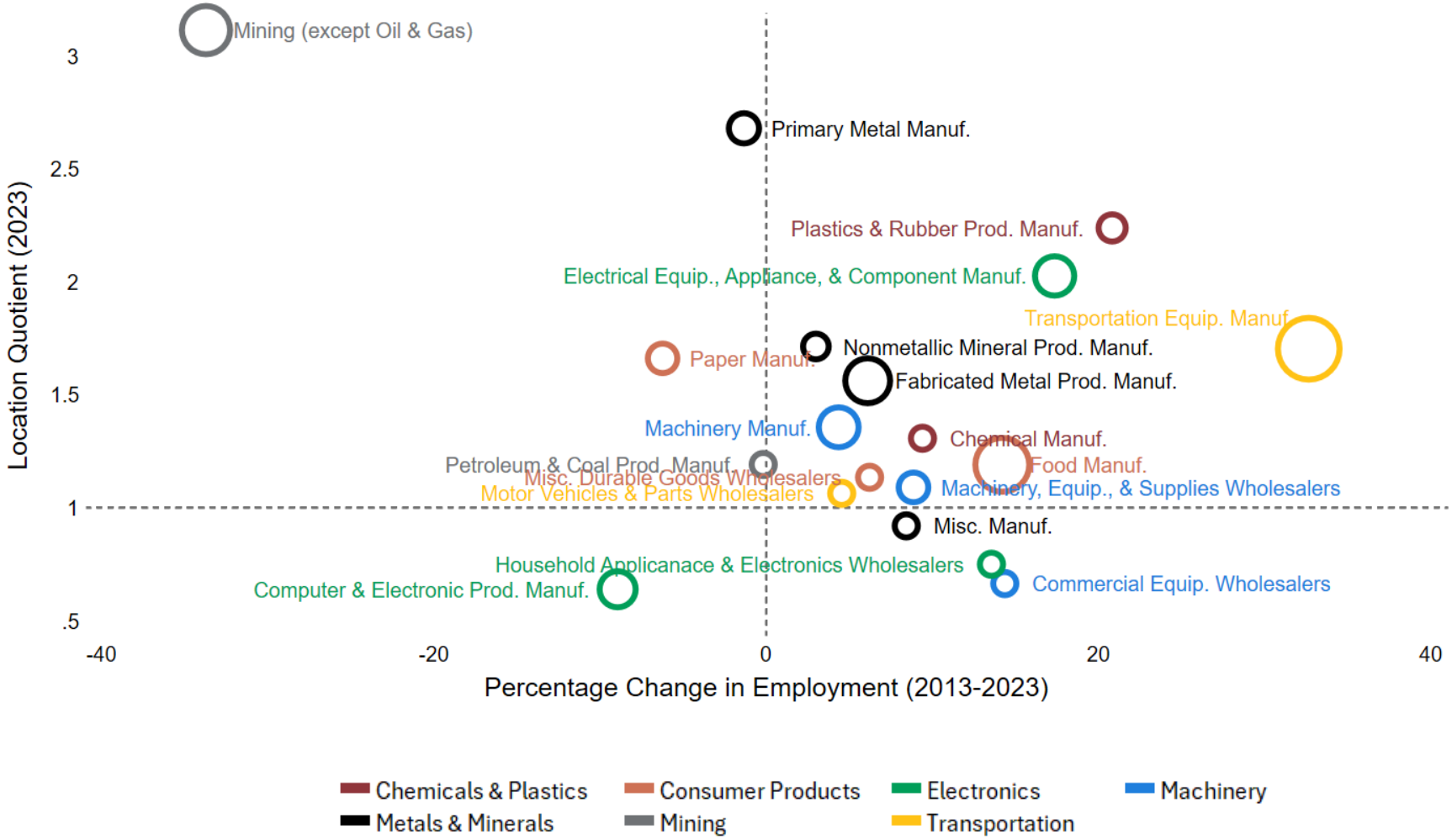


Figure 2.1.4 maps the selected industries into quadrants based on location quotient (LQ) and employment growth between 2013 and 2023. The LQ measures an industry's employment specialization in the Appalachian Region compared to the country overall, with a LQ over 1 indicating that the region is more specialized in this industry than the rest of the county.[7] Most of the industries in the export-oriented clusters fall in the upper right quadrant, which signifies both specialization and employment growth. The transportation equipment manufacturing industry has seen the most employment growth in the last decade, growing 32 percent between 2013 and 2023. In contrast to this broad trend of employment growth in regionally specialized industries, the mining industry falls in the upper left quadrant, with a very high degree of regional specialization (LQ greater than three) but a 33 percent decline in employment over the past decade.

[7] LQ is calculated by dividing the industry's share of the region's employment by the same industry's share of the national total employment.

Figure 2.1.4 Selected Industries LQ and Employment Growth



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' data-Fab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Notes: The size of the ring indicates the relative size of the employment base in the industry in 2023. For reference, the largest industry, Transportation Equipment Manufacturing, has over 200,000 employees while the smallest, Petroleum and Coal Products Manufacturing, has just under 9,000 employees.

2.1.3 Other Important Appalachian Manufacturing Industries

Several industries of regional importance are not included in the list of industry clusters. These include textiles, wood products, and furniture manufacturing. Below is a brief description of these industries, their importance to the region, and the reason they are not included in this export-focused cluster analysis.

- **Textiles products and mills:** The Appalachian Region is particularly specialized in the textile industry, with a very high LQ of 5.5 in the textile mills industry and 4.5 in the textile product mills industry, compared to the national level. In the south subregion, the LQ is over ten. Together, these industries employ over 64,000 people in Appalachia, though employment has declined by over 15 percent over the last ten years and 63 percent since 2001. In both industries, over 80 percent of production is shipped outbound from the region. However, the majority of these outbound shipments remain within the United States; the foreign export share for textile industries is less than 5 percent and the export value is only about a third of the threshold based on the top 30th percentile. As a result, the textile industries do not meet the export-oriented criteria and are not included in a cluster, despite their clear importance to Appalachia's economy.

- **Wood product manufacturing:** The Appalachian Regin also has employment concentrations in the wood product manufacturing industry (LQ of 2.4). The industry also has high and growing employment, with over 66,000 employees in 2023 and 15 percent employment growth over the last decade (although lower employment than the 93,000 employees in 2001). However, like the textile industries, wood product manufacturing does not meet the export-oriented criteria with industry exports of $1.2 billion, which accounts for about 4 percent of its total output.

- **Furniture manufacturing:** Similarly, the furniture industry, which was identified as an industry cluster in the 2004 clusters report, has a high LQ (2.6) and employment level (64,000) but does not meet the export-oriented criteria. International exports make up about 3 percent of the furniture and related products manufacturing industry and total $0.6 billion. Notably, employment in this industry, which totaled just under 64,000 in 2023, has declined slightly since its 2013 level of 65,000 and substantially since the 2001 employment of 135,000.

2.2. Chemicals and Plastics

2.2.1 Cluster Overview

190,000
employees in 2023

$72,000
average wage in 2023

$227 billion
cluster output in 2022

$5 billion
exports to Europe in 2022

16%
growth in employment over the last 10 years

$13,000
higher than the average wage in Appalachia

$20 billion
total exports in 2022

$8 billion
exported via water ports in 2022

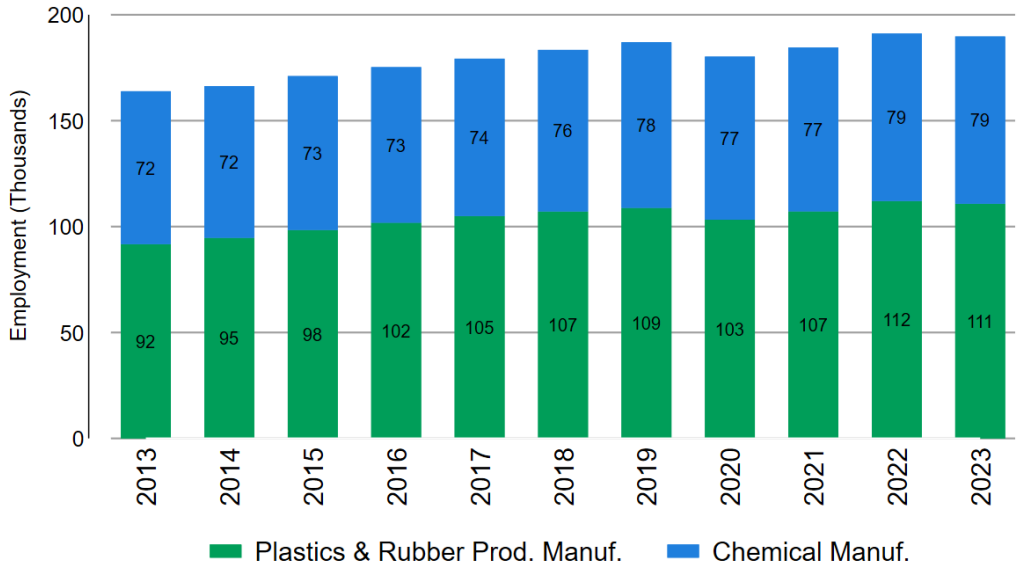
The chemicals and plastics cluster is made up of two industries:

- **Chemical Manufacturing** (NAICS 325) which transforms raw materials to products through chemical processes. This industry includes the manufacture of basic chemicals, pesticides and other agricultural products, pharmaceuticals, paints, cleaning compounds, and other chemical products.
- **Plastics and Rubber Product Manufacturing** (NAICS 326) which makes goods by processing raw plastics and rubber into products such as plastic bags, pipes and bottles or rubber tires and hoses.

2.2.2 Employment and Wages

In 2023, the chemicals and plastics cluster employed 190,000 people in Appalachia, surpassing pre-pandemic employment levels. Employment in the cluster increased steadily between 2013 and 2019, reaching 187,000 before dropping by about 7,000 employees (four percent) during the Covid-19 pandemic in 2020. The plastics and rubber product manufacturing industry made up 58 percent of the cluster's employment in 2023.

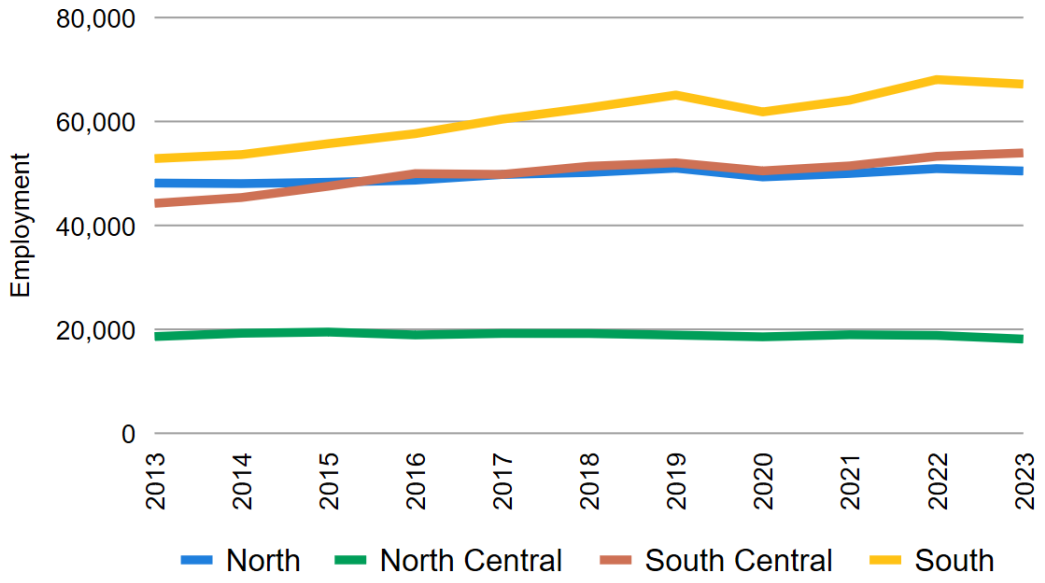
Figure 2.2.1 Employment in the Chemicals and Plastics Cluster by Industry



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

About 35 percent of the region's employment in chemicals and plastics is in the South subregion (67,000 workers). The South Central and North subregions each make up over a quarter of the employment in the cluster in 2023. Since 2013, employment has been relatively constant in the North and North Central subregions has grown by 27 percent in the South subregion and 22 percent in the South Central subregion.

Figure 2.2.2 Employment in the Chemicals and Plastics Cluster by Subregion



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

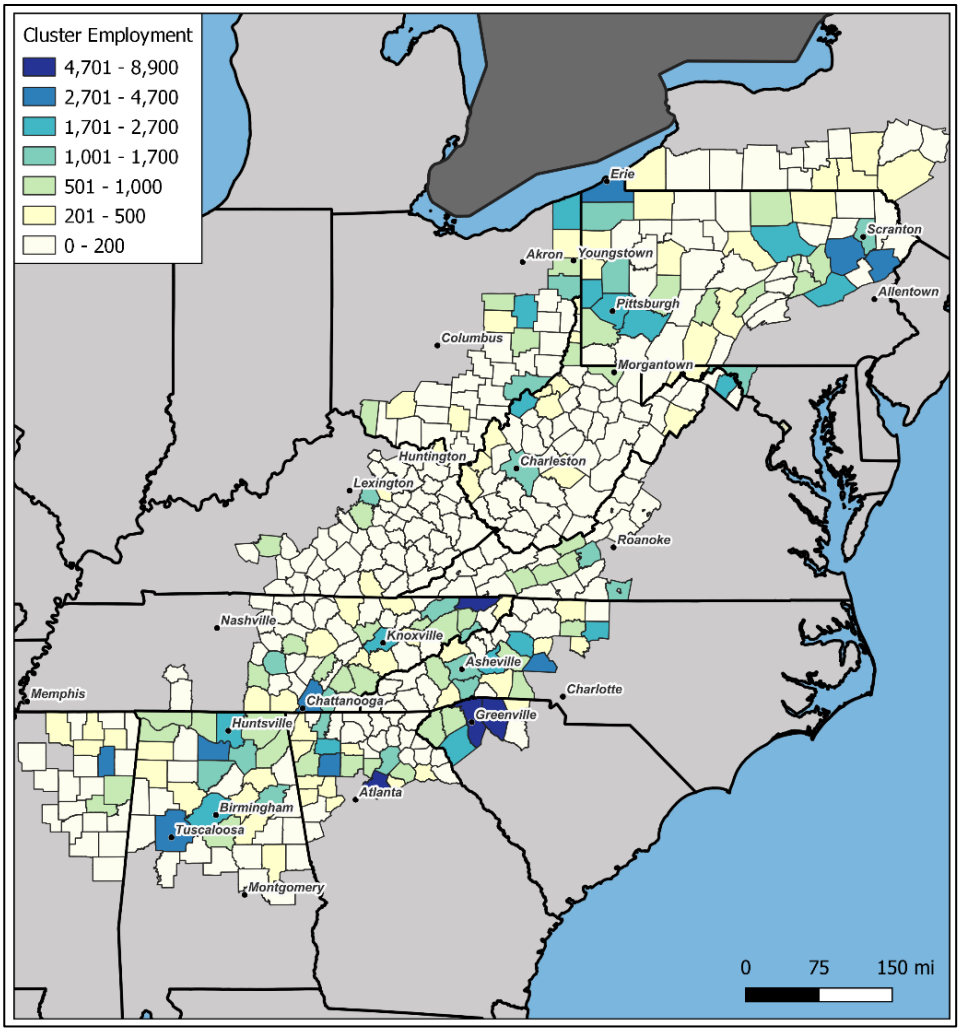
In general, employment in the chemicals and plastics cluster is prevalent throughout the region, with particularly high levels of employment in the following areas:

- Greenville and Spartanburg Counties, SC (including the city of Greenville and located near Inland Port Greer[8]) had 8,800 and 6,700 employees, respectively, in 2023
- Sullivan County, TN (where Eastman Chemical Company is headquartered) with over 8,000 employees and making up 12 percent of the county's total workforce
- Gwinnett County, GA (in the Greater Atlanta area) with 4,800 employees
- Erie County, PA with 4,400 employees

While employment levels are not particularly high in West Virginia, the chemicals and plastics cluster makes up a high share of the total employment in several counties in the state. In Pleasants and Tyler counties, chemicals and plastics make up over a quarter of all employees, though employment in the counties is only 380 and 500 respectively.

[8] For more information on the inland port, see https://scspa.com/facilities/inland-port-greer/.

Figure 2.2.3 Chemicals and Plastics Employment Concentrations by County, 2023



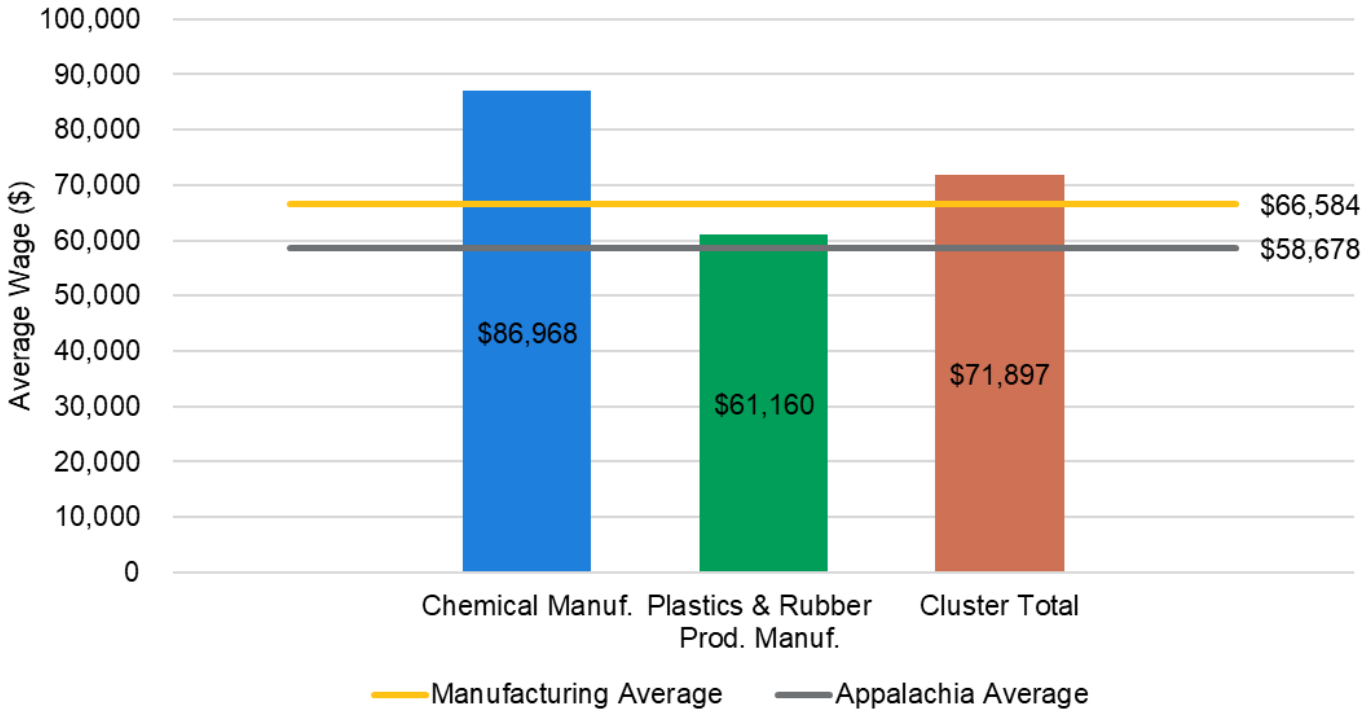
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the chemical manufacturing industry in Appalachia averaged about $87,000 in 2023, substantially higher than plastics and rubber products manufacturing ($61,000). This discrepancy may be due to the different skillset required in each industry. For example, the National Industry-Occupation Matrix from the BEA shows that other than production occupations, the most common occupations in chemical manufacturing are management (10 percent of the industry's employment) and life, physical, and social science[9] (9 percent). These occupations pay average annual wages of $138,000 and $88,000, respectively. Alternatively, the most

[9] Jobs in this occupation include chemical technicians and chemists.

common occupations in plastics and rubber (other than production occupations) are transportation and material moving (11 percent) and office and administrative support (7 percent), which pay average annual wages of $47,000 and $48,000, respectively.

Figure 2.2.4 Wages in the Chemicals and Plastics Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.2.3 Export Activity and Key Ports

Of the $227 billion of chemicals and plastics products produced in Appalachia in 2022, $168 billion (74 percent) was shipped outside of the region and $20 billion (9 percent) was exported to other countries. Approximately three quarters of the cluster's exports came from the chemical manufacturing industry ($15 billion).

In 2022, the North subregion exported the most chemicals and plastics products, totaling $6.2 billion, followed by the South with $5.8 billion. While exports from the South Central subregion were slightly lower in that year ($5.4 billion), the subregion has seen the fastest growth over the last few years, growing by about 40 percent since 2017. Exports from the North Central subregion were smallest, with a total of $2.4 billion in 2022. Despite

exports values being lowest in the North Central subregion, that area has the highest export intensity (over 11 percent). In contrast, exports make up a lesser share of the total chemicals and plastics value generated in the South subregion (7 percent).

Table 2.1 Chemical and Plastics Outbound and Export Value and Intensity, 2022

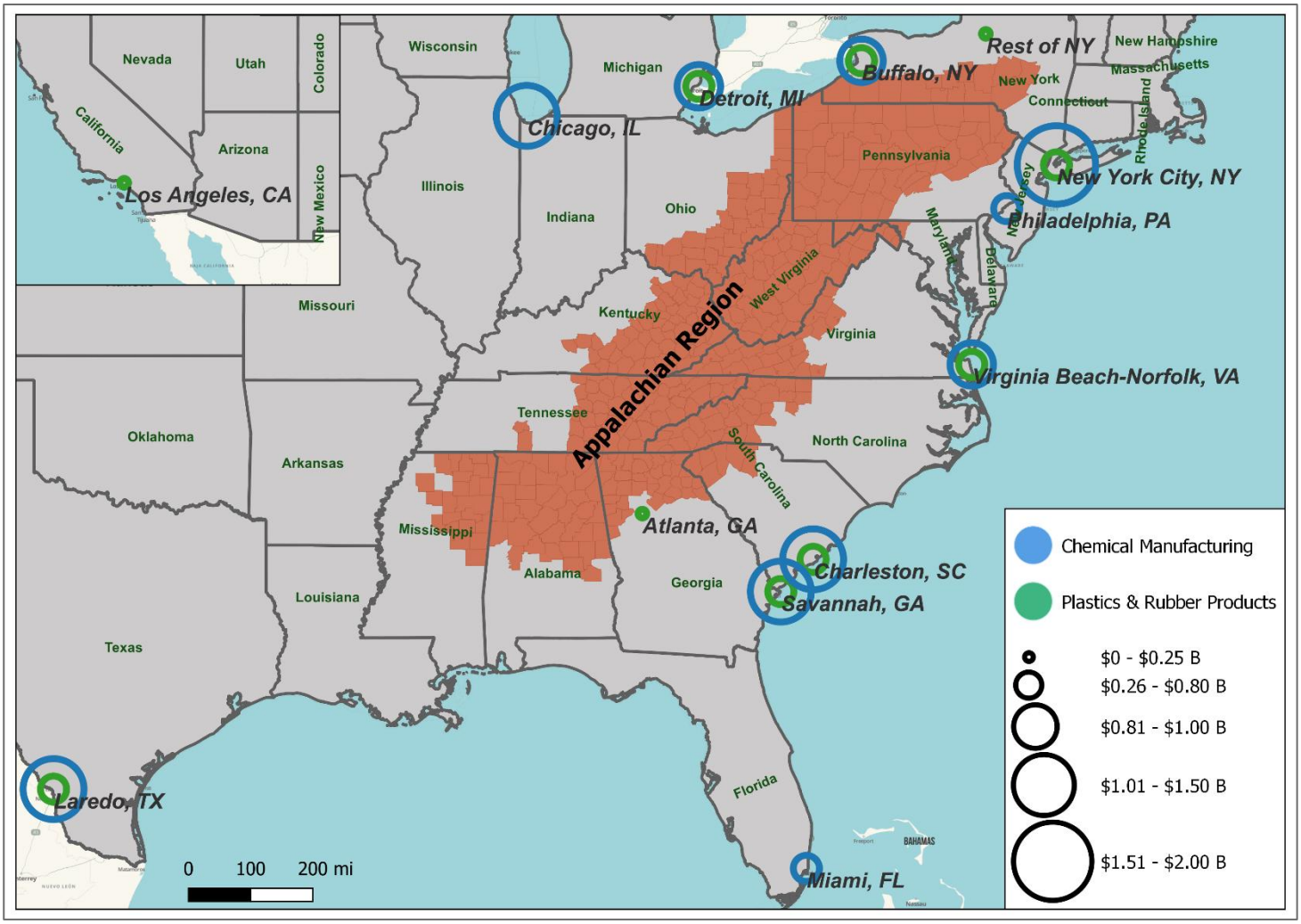
	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Chemicals & Plastics	$227.1	$167.6	$19.9	74%	9%
By Industry					
Chemical Manuf.	$174.9	$128.7	$14.9	74%	8%
Plastics & Rubber Prod. Manuf.	$52.2	$38.9	$5.0	75%	10%
By Region					
North	$71.5	$56.5	$6.2	79%	9%
North Central	$21.3	$17.6	$2.4	82%	11%
South Central	$54.9	$48.6	$5.4	88%	10%
South	$79.4	$62.5	$5.8	79%	7%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Chemical and plastics exports grew by 8 percent between 2020 and 2022, reaching pre-pandemic export levels by 2022. This growth in exports was driven by the chemical manufacturing industry, which grew by 10 percent from $13.5 billion to $14.9 billion while plastics and rubber manufacturing exports remained around $5 billion.

About 13 percent ($1.9 billion) of the chemical manufacturing products exported from the Appalachian Region leave the United States via the Port of New York City. The next largest ports of exit are Laredo, TX (mostly goods trucked into Mexico) and Savannah, GA, each accounting for about 8 percent of the total exports. Plastics and rubber product manufacturing, which exports less total value than the chemical manufacturing industry, primarily uses ports in Charleston, SC and Laredo, TX for its foreign exports. Together, these two areas are the ports of exit for about one fourth ($1.2 billion) of the region's plastics and rubber products exports.

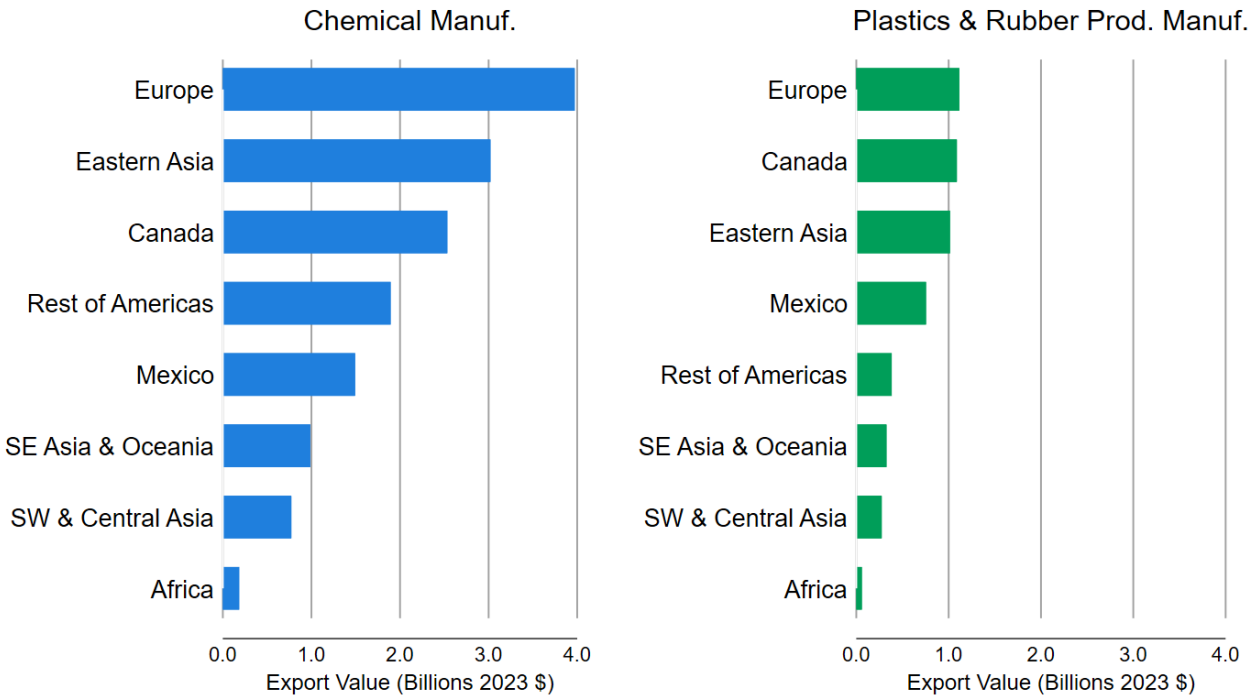
Figure 2.2.5 Top Ports of Exit for the Chemical and Plastics Cluster by Industry, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

In both industries, Europe is a key trading partner, accounting for over $5 billion of the cluster's exports, followed by Eastern Asia ($4.9 billion) and Canada ($3.6 billion). Together, these three regions account for about 64 percent of Appalachia's exports in the chemical and plastics cluster.

Figure 2.2.6 Chemicals and Plastics Cluster Export Destinations, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.2.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, most chemicals and plastics products are shipped by truck (67 percent for chemical products and 74 percent for plastics and rubber). For products that are high value and low weight, air transportation is a feasible option: 45 percent of pharmaceutical products and 22 percent of all chemical products travel by air en route to a port of exit. In contrast, a lower share (8 percent) of plastics and rubber products rely on domestic air transport to their ports of exit.

From the port of exit to the final destination, chemicals and plastics products are transported most frequently by water. Like domestic transportation, air is also a common mode of transport for the chemical manufacturing industry (driven by pharmaceutical products), with more than one third of export value transported internationally by air. Plastics and rubber products, which have a higher share of trade with Mexico and Canada than the chemical industry, depend on truck transport for 31 percent of exports.

Table 2.2 Chemicals and Plastics Cluster Export Mode from Appalachia, 2022

Chemical Manuf.			Plastics & Rubber Prod. Manuf.		
Mode	Export Value (Billions)	Share of Total Exports	Mode	Export Value (Billions)	Share of Total Exports
Water	$5.93	40%	Water	$2.34	47%
Air (including truck-air)	$5.08	34%	Truck	$1.57	31%
Truck	$3.48	23%	Air (including truck-air)	$0.87	17%
Rail	$0.33	2%	Rail	$0.22	4%
Multiple modes & mail	$0.04	<1%	Multiple modes & mail	$0.02	<1%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.3. Consumer Products

2.3.1 Cluster Overview

204,000
employees in 2023

$59,000
average wage in 2023

$220 billion
cluster output in 2022

$2.1 billion
exports to Canada in 2022

9%
growth in employment over the last 10 years

-$8,000
lower than the average manufacturing wage in Appalachia

$10 billion
total exports in 2022

50%
value exported via water ports in 2022

The consumer products cluster is made up of three industries:

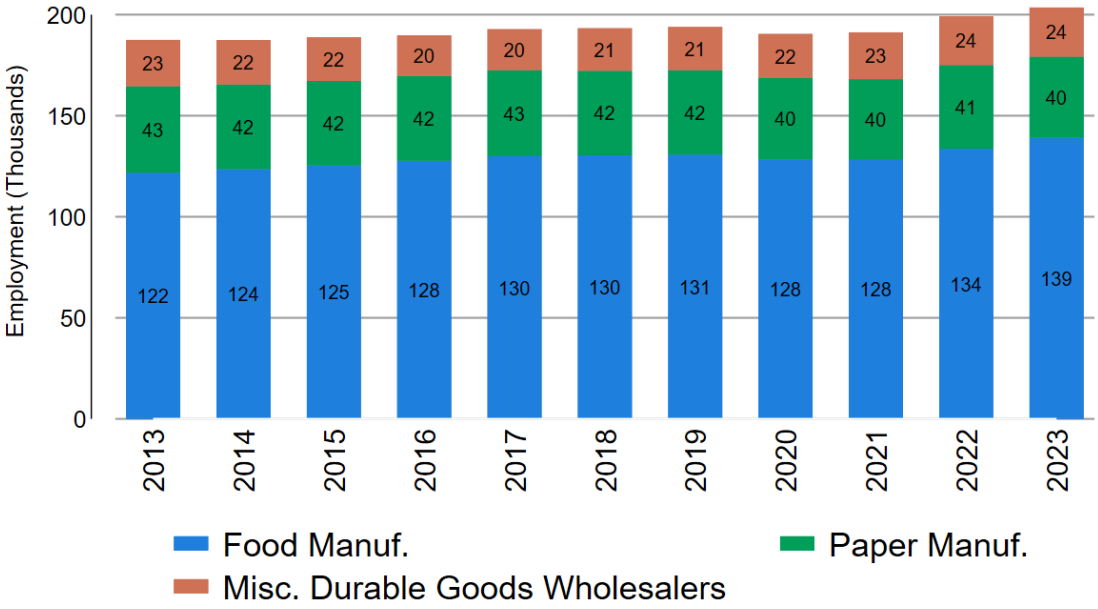
- **Food Manufacturing** (NAICS 311) which includes the transformation from agricultural and animal products into food for intermediate or final consumption.

- **Paper Manufacturing** (NAICS 322) which includes the manufacturing of pulp, paper, and converted paper products.
- **Miscellaneous Durable Goods Wholesalers** (NAICS 4239) includes the distribution of other durable goods such as recreational equipment, craft supplies, jewelry, and other goods.

2.3.2 Employment and Wages

In 2023, the consumer products cluster employed 204,000 people in Appalachia. The food manufacturing industry grew from 122,000 employees in Appalachia 2013 to 139,000 in 2023, representing about 68 percent of the cluster employment. The relatively smaller paper manufacturing and miscellaneous durable goods wholesalers industries remained relatively constant over the period.

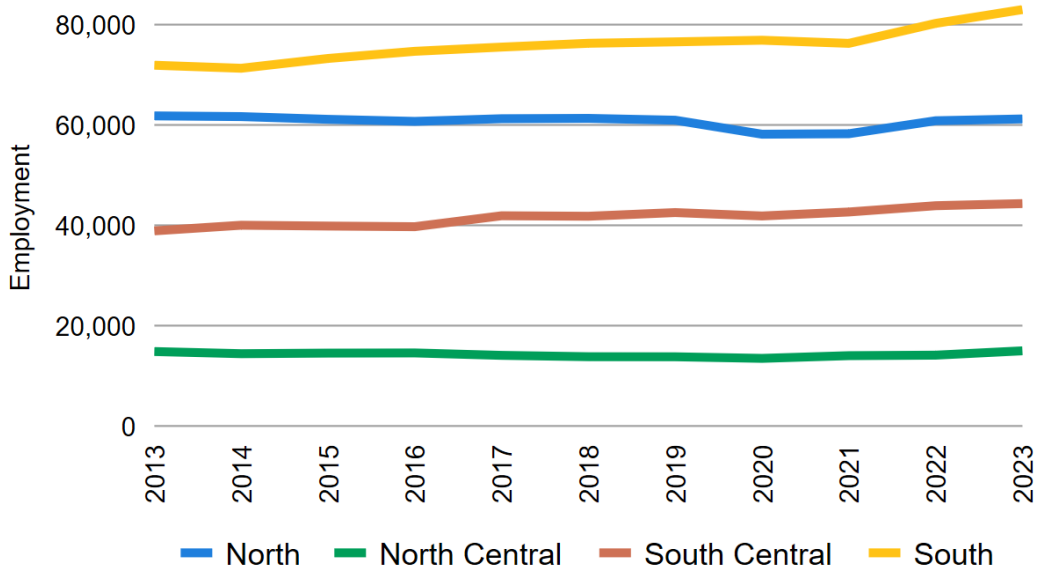
Figure 2.3.1 Employment in the Consumer Products Cluster by Industry



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

About 41 percent of the region's employment in the consumer products cluster was in the South subregion in 2023 (83,000 workers). Both the South and South Central subregions experienced the fastest growth over the last decade, increasing by about 15 percent, while the employment in the North and North Central subregions remained more constant.

Figure 2.3.2 Employment in the Consumer Products Cluster by Subregion



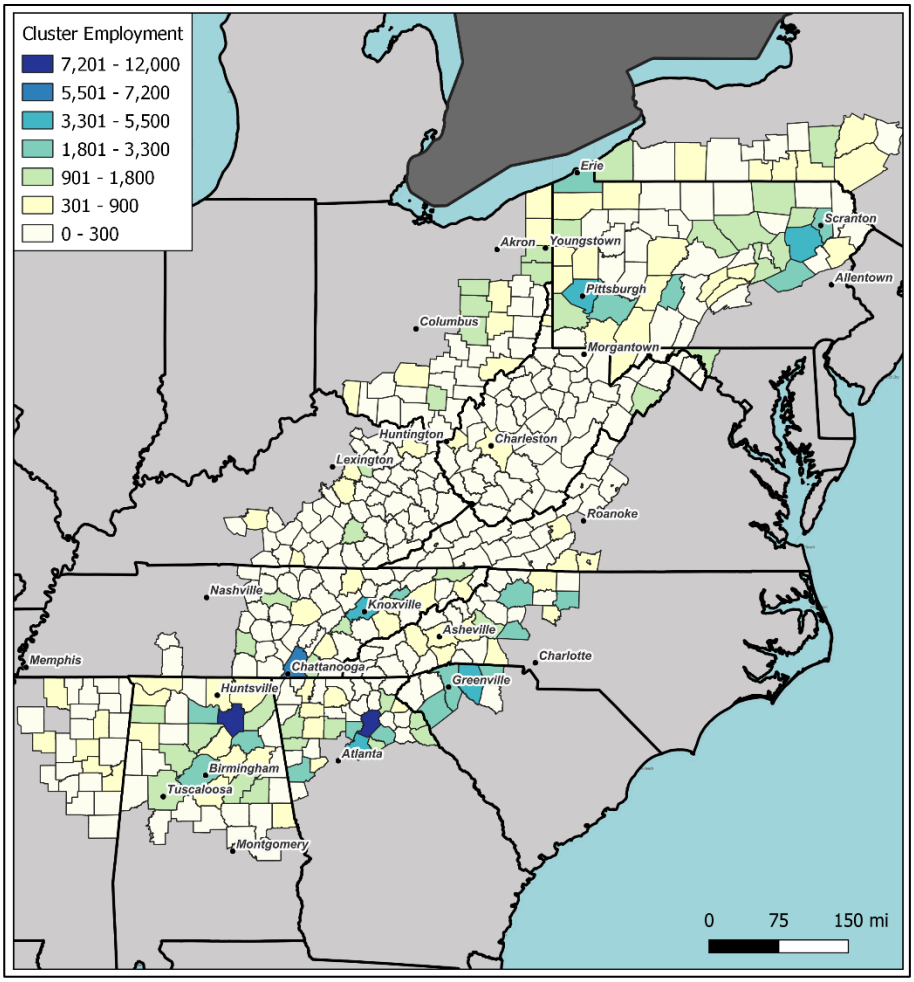
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Counties with particularly high levels of employment in the consumer products cluster include:

- Hall County, GA with over 12,000 employees
- Marshall County, AL with 7,300 employees
- Hamilton County, TN (which includes the city of Chattanooga) with 7,100 employees

In some areas, consumer product jobs make up a high share of overall employment. For example, in Hardy County, WV and Clay County, AL, the cluster accounts for about one third of all jobs (despite the number of consumer product jobs in each county being less than 2,000). In Clinton County, KY, the cluster employs just over 800 people, which accounts for about 28 percent of the total jobs in the county.

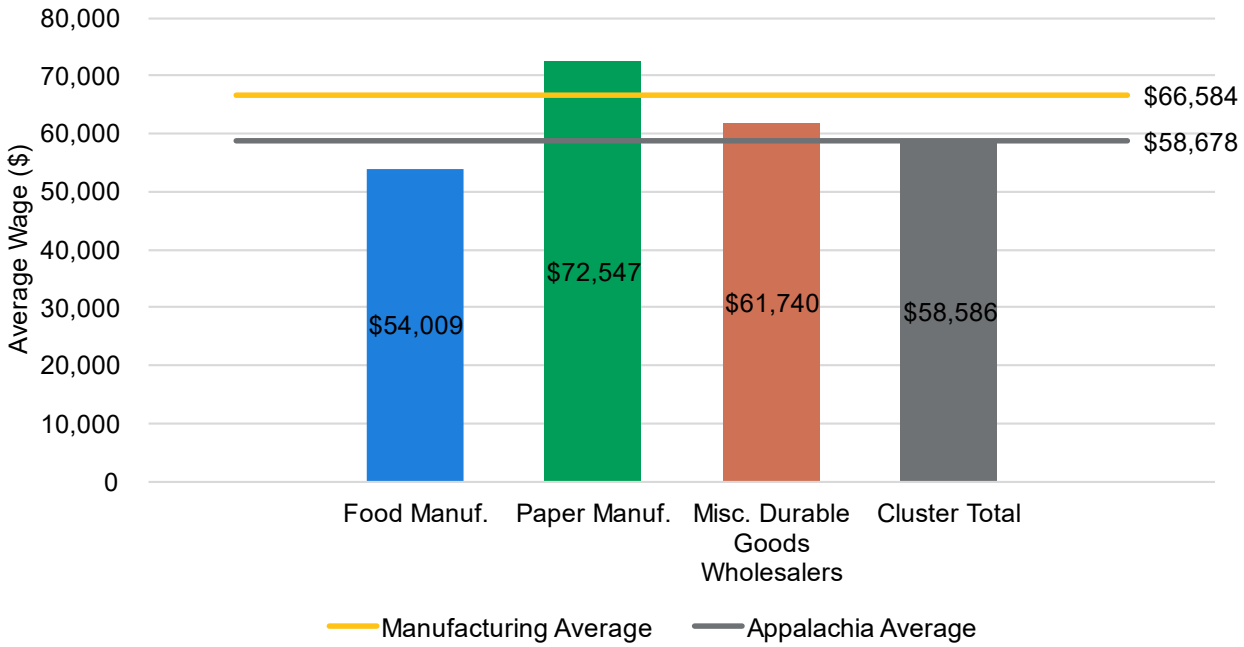
Figure 2.3.3 Consumer Products Employment Concentrations by County, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the paper manufacturing industry in Appalachia averaged about $73,000 in 2023, substantially higher than food manufacturing ($54,000). Overall, the cluster's average wages are in line with the average wage in Appalachia (about $59,000) but lower than the average manufacturing job in the region ($67,000).

Figure 2.3.4 Wages in the Consumer Products Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.3.3 Export Activity and Key Ports

Of the $220 billion of consumer products produced in Appalachia in 2022, $160 billion (73 percent) was shipped outside of the region. A much smaller share (5 percent) was exported to other countries totaling $10.2 billion. Food manufacturing is the largest industry in the cluster, with $150 billion in output in 2022. Nonetheless, all industries exported similar values in that year ($3.6 billion in food manufacturing and $3.3 billion in paper manufacturing and $3.2 billion from durable goods wholesalers). In 2022, the South subregion exported the most consumer products, totaling $4.6 billion, about 45 percent of Appalachia's total exports.

Table 2.3 Consumer Products Outbound and Export Value and Intensity, 2022

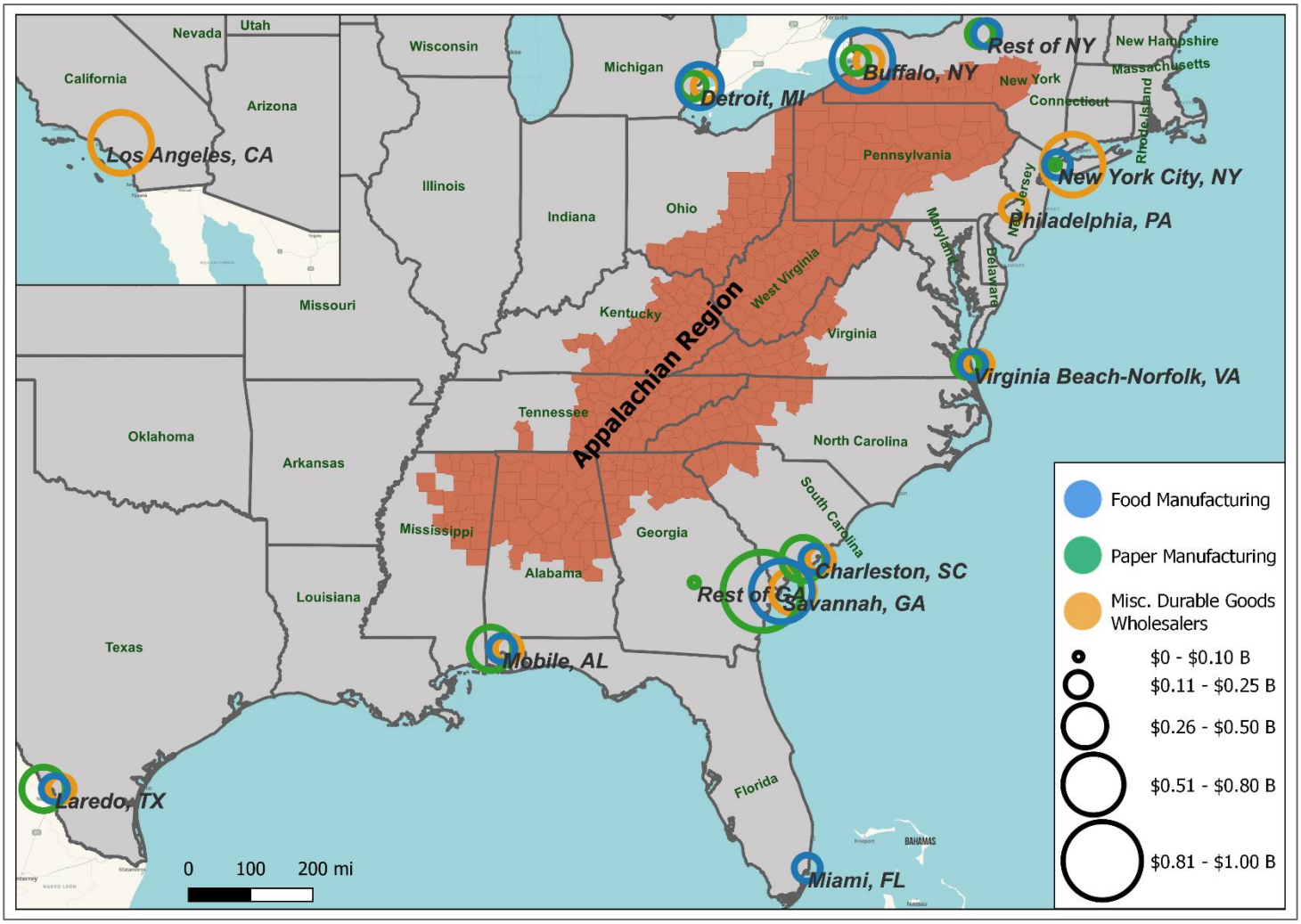
	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Consumer Products	$220.0	$159.9	$10.2	73%	5%
By Industry					
Food Manuf.	$150.2	$107.6	$3.6	72%	2%
Paper Manuf.	$40.6	$31.2	$3.3	77%	8%
Misc. Durable Goods Wholesalers	$29.2	$21.2	$3.2	73%	11%
By Region					
North	$79.2	$59.9	$2.8	76%	4%
North Central	$13.9	$11.4	$0.3	82%	3%
South Central	$56.0	$47.2	$2.5	84%	4%
South	$70.8	$54.6	$4.6	77%	6%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Paper and food product exports fell by about 4 percent between 2017 and 2022, from $7.3 billion to $7.0 billion. At the same time, exports from miscellaneous durable goods wholesalers increased 51 percent.

The consumer products cluster relies heavily on the Port of Savannah, GA, which is the port of exit for about 20 percent of Appalachia's exports. For food manufacturing, Canada is a key trading partner (see below), so Buffalo and other parts of New York (not including New York City) and Detroit, MI also serve as important ports of exit, accounting for 27 percent of industry's exports. For paper manufacturing, almost a third of exports move through water ports in Mobile, AL and Charleston, NC or the trucking port in Laredo, TX. Durable goods, on the other hand, are most frequently shipped through ports in New York City, NY (23 percent of the industry's exported value) and Los Angeles, CA (17 percent) likely via shipping containers.

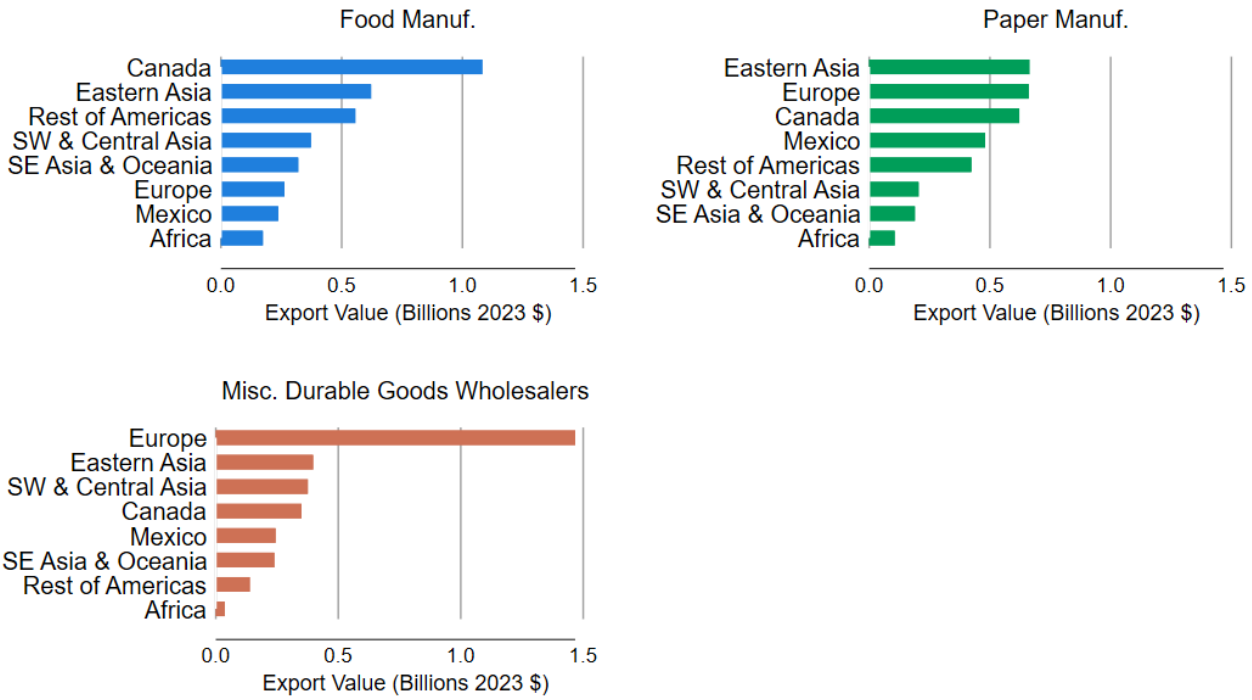
Figure 2.3.5 Top Ports of Exit for the Consumer Products Cluster by Industry, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Rings are offset from port centroids so each industry's ring is visible.

Canada is the most common trading partner for Appalachia's food exports, totaling over $1 billion in 2022 and making up 30 percent of the industry's exports. For non-perishable paper products, the farther destinations of Eastern Asia and Europe are most common, each totaling $0.66 billion in 2022. Similarly, Europe is the largest importer of goods exported by durable good wholesalers and accounts for over 45 percent of those shipments.

Figure 2.3.6 Consumer Products Cluster Export Destinations, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.3.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, most consumer products are shipped by truck (84 percent of food products, 69 percent of paper, and 65 percent of durable goods). For paper products (often a bulk commodity), rail is also a popular mode of transportation to a port of exit, accounting for 23 percent of Appalachia's exports of the product and air transports about 25 percent of durable goods en route to the port of exit.

From the port of exit to the final destination, food and paper products are transported most frequently by water (58 percent and 64 percent, respectively) or truck (33 percent and 21 percent). Durable goods, on the other hand, tend to be shipped by air (37 percent) and truck (34 percent).

Table 2.4 Consumer Products Cluster Export Mode from Appalachia, 2022

Food Manuf.			Paper Manuf.			Misc. Durable Goods Wholesalers		
Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports
Water	$2.10	58%	Water	$2.14	64%	Air (including truck-air)	$1.10	37%
Truck	$1.21	33%	Truck	$0.71	21%	Truck	$1.02	34%
Air (including truck-air)	$0.16	5%	Rail	$0.35	11%	Water	$0.77	26%
Other and unknown	$0.08	2%	Air (including truck-air)	$0.14	4%	Rail	$0.09	3%
Rail	$0.07	2%	Other and unknown	$0.01	<1%	Multiple modes & mail	$0.01	<1%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.4. Electronics

2.4.1 Cluster Overview

123,000
employees in 2023

$80,000
average wage in 2023

$110 billion
cluster output in 2022

$3.5 billion
exports to Canada in 2022

5%
growth in employment over the last 10 years

$22,000
higher than the average wage in Appalachia

$14 billion
total exports in 2022

52%
export value shipped via air in 2022

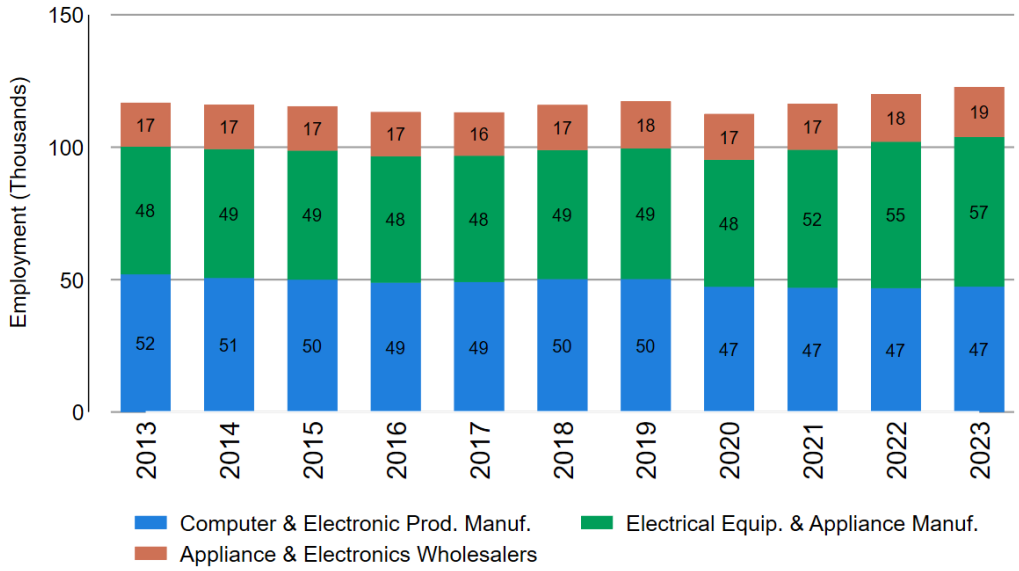
The electronics cluster is made up of three industries:

- **Computer and Electronic Product Manufacturing** (NAICS 334) which includes the manufacturing of computers, communication equipment, and other electronic products.
- **Electrical Equipment and Appliance Manufacturing** (NAICS 335) which covers the manufacturing of products like electric motors, generators, transformers, and household appliances.
- **Appliance and Electronics Wholesalers** (NAICS 4236) which includes the distribution of electrical apparatus and equipment, household appliances, wiring, and consumer electronics.

2.4.2 Employment and Wages

In 2023, the electronics cluster employed 123,000 people in Appalachia. That year, the electrical equipment and appliance manufacturing industry employed 56,600 people in the region and accounted for 46 percent of the cluster's total employment. While that industry saw growth over the last decade, computer and electronic product manufacturing declined from 52,000 employees in 2013 to 47,000 in 2023. The relatively smaller appliance and electronics wholesale industry employed 19,000 people in 2023, up from 16,500 in 2013.

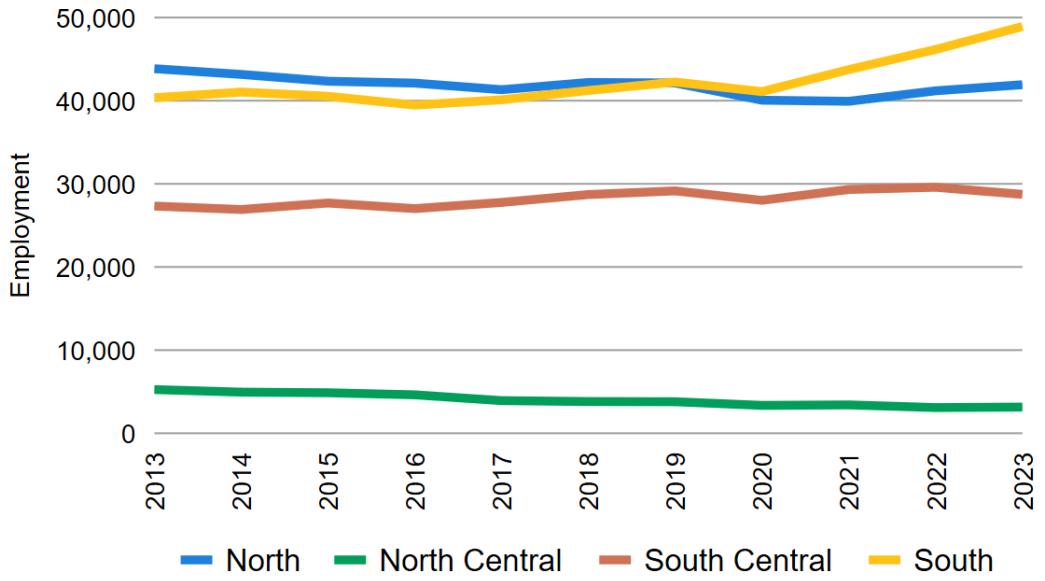
Figure 2.4.1 Employment in the Electronics Cluster by Industry



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

The South subregion had the highest employment in the electronics cluster in 2023 with a total of almost 50,000 employees. Between 2020 and 2023, the South experienced a 19 percent increase in employment, after growing only 2 percent in the eight years prior. In contrast, employment in electronics in the North Central subregion declined by 40 percent, from 5,300 in 2013 to 3,200 in 2023.

Figure 2.4.2 Employment in the Electronics Cluster by Subregion



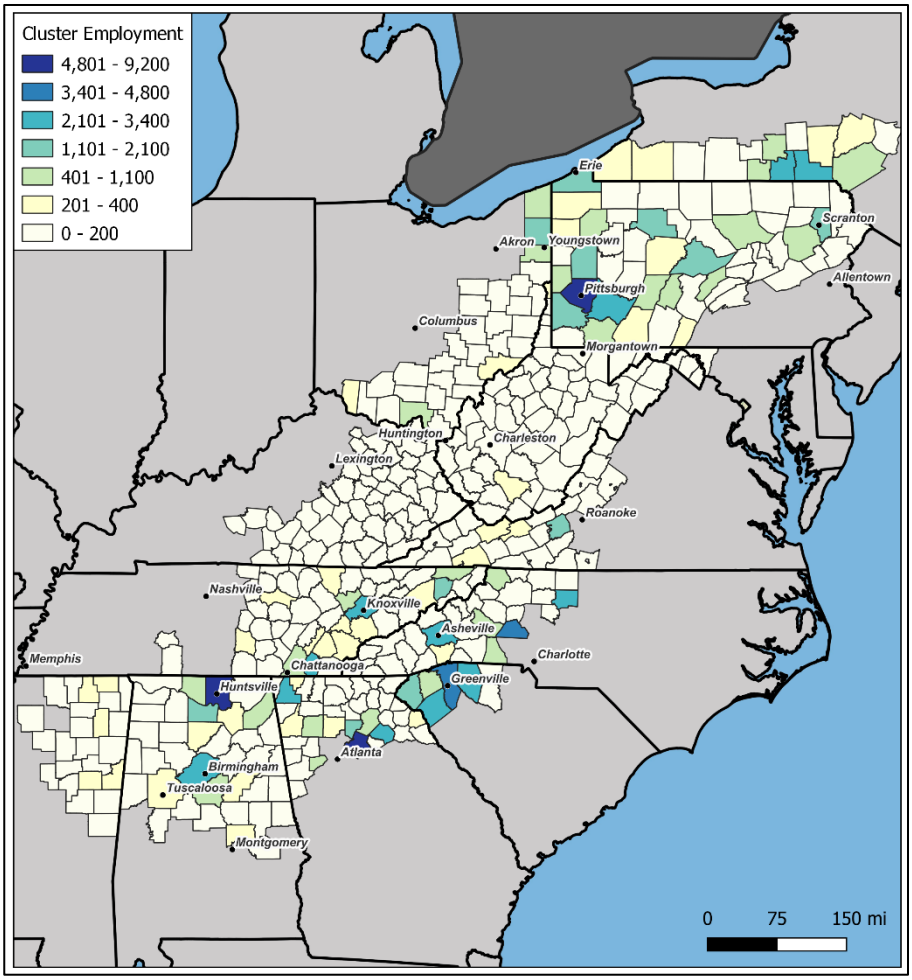
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Several counties with large urban centers have particularly high employment levels in the electronics cluster:

- Gwinnett County, GA (in the Greater Atlanta area) with 9,200 employees
- Allegheny County, PA (which includes the city of Pittsburgh) with 8,200 employees
- Madison County, AL (which includes the city of Huntsville) with 4,800 employees
- Greenville County, SC (which includes the city of Greenville) with 4,500 employees

Some more rural areas also have concentrations in electronics employment, such as Broome and Tioga Counties in NY, with 3,100 and 2,300 employees. In some smaller counties, electronics jobs make up a high share of overall employment, even if the total number of employees is relatively low. In Bland County, VA, one quarter of all jobs are within the electronics cluster. In Walker County, GA and Tioga County, NY, about 22 percent of all jobs are in electronics.

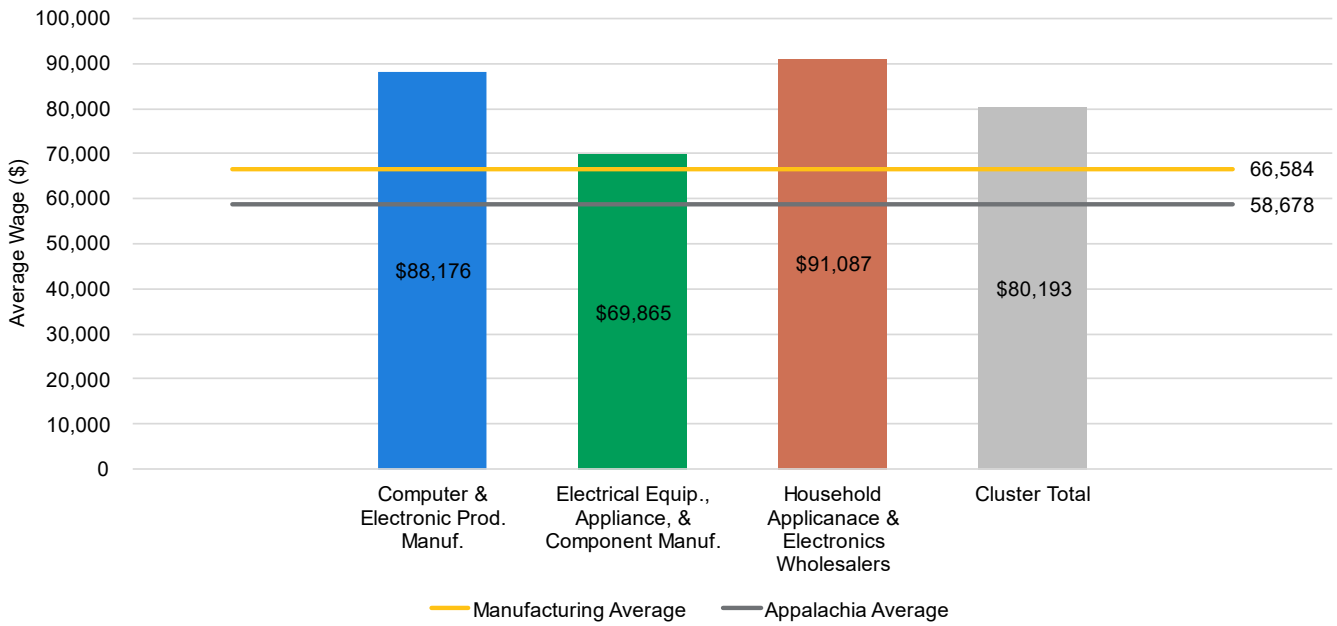
Figure 2.4.3 Electronics Employment Concentrations by County, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the electronics cluster vary by industry but are generally higher than the average wage in the region. Household appliance and electronics wholesalers earn the highest wages ($91,000) followed by computer and electronic product manufacturers ($88,000). Wages in the electronics cluster are substantially higher than the average wage in Appalachia, which is about $59,000.

Figure 2.4.4 Wages in the Electronics Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.4.3 Export Activity and Key Ports

Of the $110 billion of electronics produced in Appalachia in 2022, $83 billion (76 percent) was shipped outside of the region and $14 billion (12 percent) was exported to other countries. Computer & electronic product manufacturing was the largest industry in 2022, producing $61 billion and exporting $8.2 billion. Despite having slightly fewer employees than the South (see above), the North subregion produced the largest value of electronics in 2022 ($42 billion). At the same time, the South Central subregion had the largest export value in 2022 ($4.8 billion) due to its relatively high export share (19 percent).

Table 2.5 Electronics Outbound and Export Value and Intensity, 2022

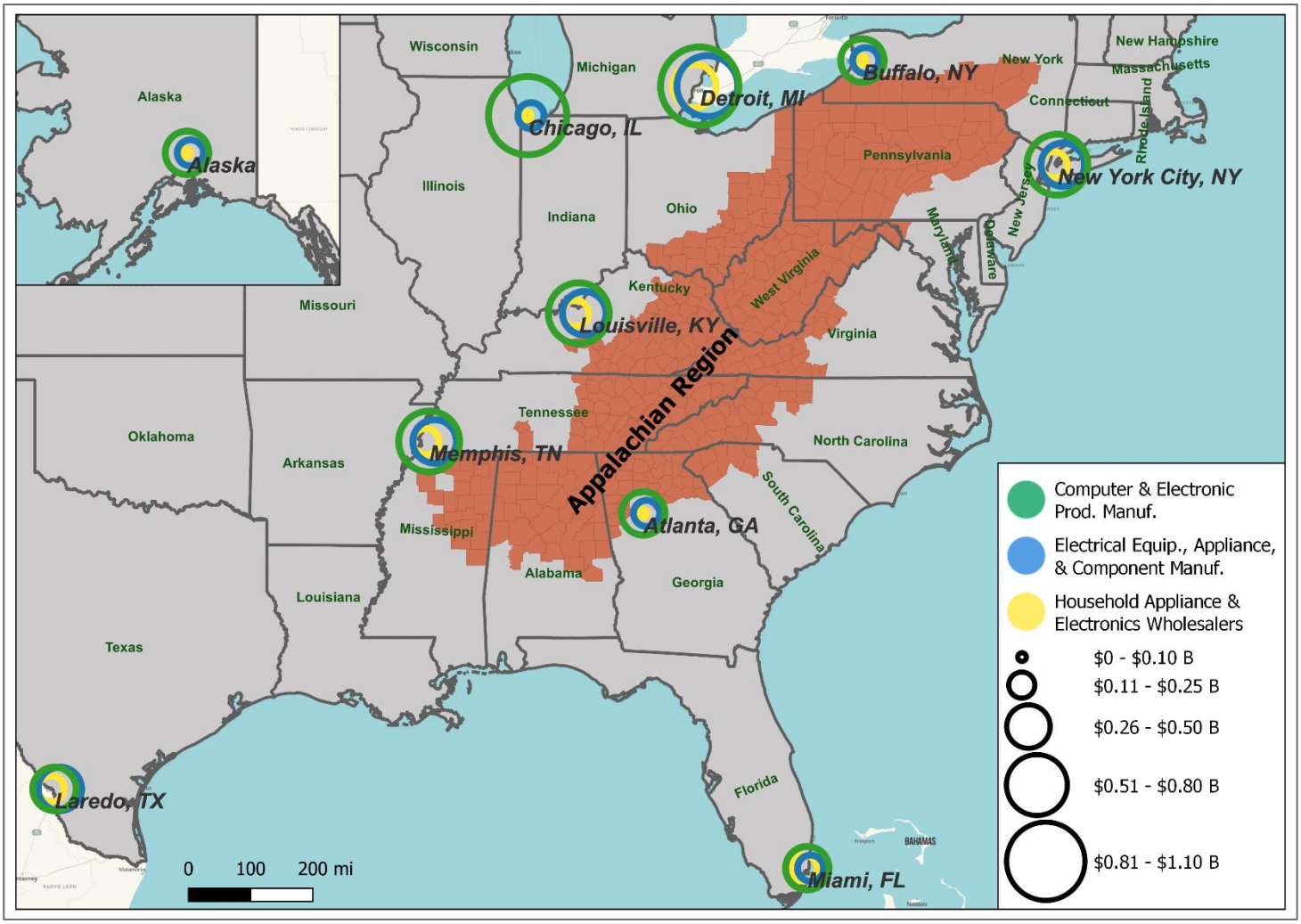
	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Electronics	$110.2	$83.3	$13.7	76%	12%
By Industry					
Computer & Electronic Prod. Manuf.	$61.0	$45.8	$8.2	75%	13%
Electrical Equip., Appliance, & Component Manuf.	$33.7	$25.6	$3.8	76%	11%
Household Appliance & Electronics Wholesalers	$15.5	$11.9	$1.7	77%	11%
By Region					
North	$41.6	$34.0	$4.0	82%	10%
North Central	$5.8	$4.5	$0.9	77%	16%
South Central	$25.6	$21.1	$4.8	83%	19%
South	$37.2	$30.9	$4.1	83%	11%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Electronics exports increased by 22 percent between 2017 and 2022, from $11.3 billion to $13.7 billion. All three industries in the cluster experienced substantial growth in exports during the period, though computer and electronics product manufacturing grew the fastest ($1.7 billion, a 26 percent increase).

Detroit, MI is the top port of exit for all three industries in the electronics cluster, with over $2 billion of Appalachia's exports moving through the city. Buffalo, NY and Chicago, IL, other ports connecting the United States with Canada, are also commonly used for Appalachia's electronics exports. Given that many electronics products tend to be high value and low weight, several regions with inland airports are used to export products from Appalachia, including Memphis, TN ($1.2 billion), Louisville, KY ($1.0 billion), and Atlanta, GA ($0.5 billion). Memphis and Louisville are also major shipping hubs for private shipping companies such as FedEx and UPS, which contributes to their importance as inland ports of exit for this cluster. Alaska is also an important port of exit, likely moving electronics exports to trading partners in Asia.

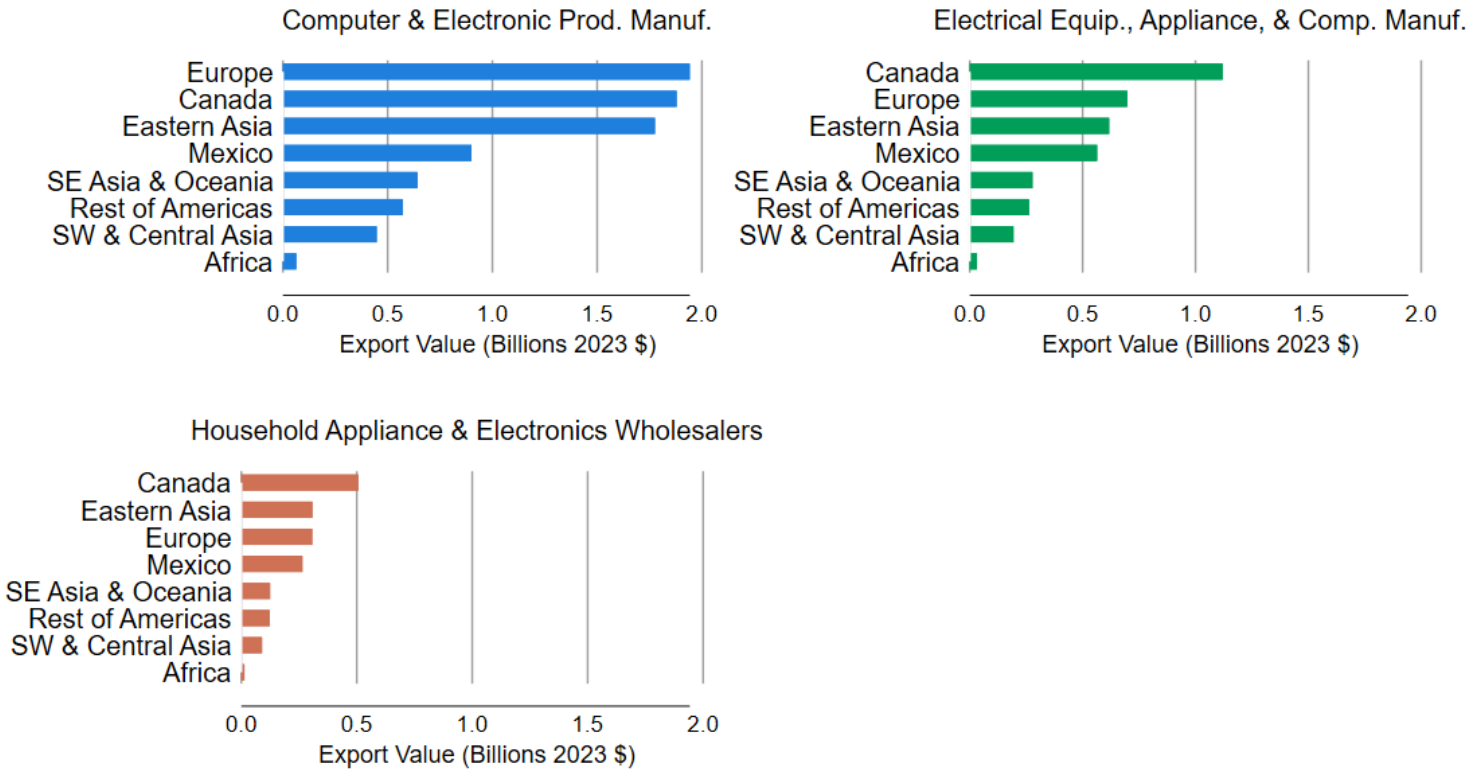
Figure 2.4.5 Top Ports of Exit for the Electronics Cluster by Industry, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Rings are offset from port centroids so each industry's ring is visible.

Over one quarter of electronics exports from Appalachia are to Canada, totaling over $3.5 billion in 2022. Europe is the next largest importer of Appalachia's electronics, totaling $2.9 billion in 2022.

Figure 2.4.6 Electronics Cluster Export Destinations, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.4.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, most electronics (61 percent) are shipped by truck. Because electronics tend to be high value and low weight, air transport is also a common mode of transportation from Appalachia to the port of exit, accounting for 35 percent of electronics exports.

From the port of exit to the final destination, electronics are transported most frequently by air (52 percent of the total exports). Trucking is a common mode of transport for products shipped to Mexico and Canada and is used to transport a 32 percent of electronics exports.

Table 2.6 Electronics Cluster Export Mode from Appalachia, 2022

Computer & Electronic Prod. Manuf.			Electrical Equip., Appliance, & Component Manuf.			Household Appliance & Electronics Wholesalers		
Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports
Air (including truck-air)	$4.68	57%	Air (including truck-air)	$1.68	45%	Air (including truck-air)	$0.82	47%
Truck	$2.31	28%	Truck	$1.44	38%	Truck	$0.66	38%
Water	$1.16	14%	Water	$0.59	16%	Water	$0.24	14%
Rail	$0.04	<1%	Rail	$0.04	1%	Rail	$0.01	1%
Multiple modes & mail	$0.04	<1%	Multiple modes & mail	$0.01	<1%	Multiple modes & mail	$0.00	<1%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.5. Machinery

2.5.1 Cluster Overview

192,000
employees in 2023

$82,000
average wage in 2023

$117 billion
cluster output in 2022

$3.8
exports to Canada in 2022

7%
growth in employment over the last 10 years

$24,000
higher than the average wage in Appalachia

$13 billion
total exports in 2022

41%
export value shipped via air in 2022

The machinery cluster is made up of three industries:

- **Machinery Manufacturing** (NAICS 333) which includes the manufacturing of all machinery end

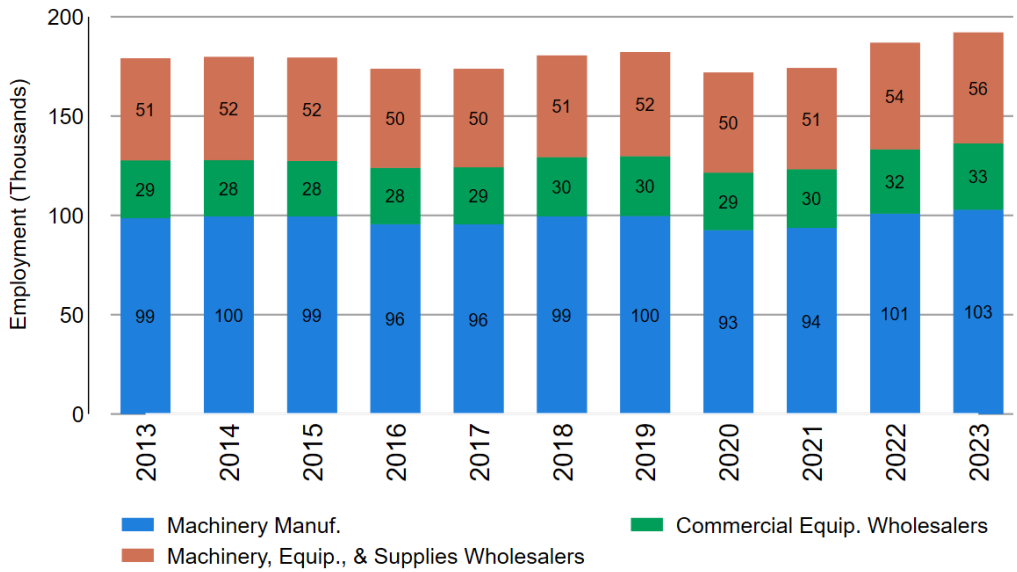
products that use mechanical force to forge, stamp, bend, weld, or assemble.

- **Commercial Equipment Wholesalers** (NAICS 4234) which covers the distribution of professional and commercial equipment such as office and computer equipment or medical or dental supplies.
- **Machinery and Equipment Supplies Wholesalers** (NAICS 4238) which includes the distribution of construction, mining, farm, garden, and industrial machinery, equipment, and supplies.

2.5.2 Employment and Wages

In 2023, the machinery cluster employed 192,000 people in Appalachia. The machinery manufacturing industry is the largest employer, accounting for over half of the cluster's total employment each year (just over 100,000 jobs). The steady growth in the cluster's employment over the last decade was spread across the three industries, each of which saw an increase in employment over the period. However, the commercial equipment wholesalers industry grew at the fastest pace (14 percent) while machinery manufacturing grew the slowest (4 percent).

Figure 2.5.1 Employment in the Machinery Cluster by Industry

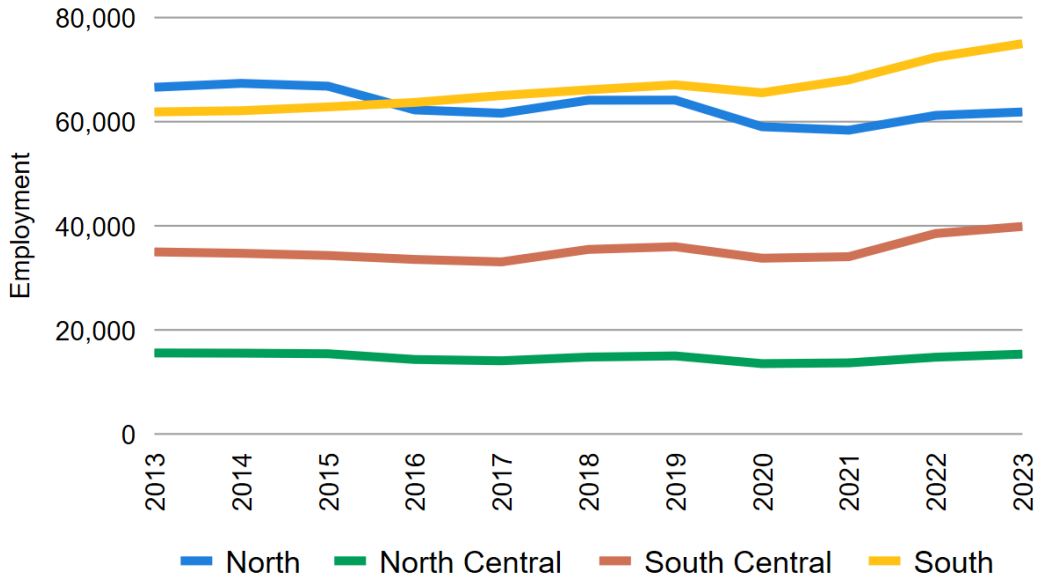


Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

About 40 percent of the region's employment in the machinery cluster was in the South subregion in 2023 (75,000 workers). Employment in the South subregion also grew the fastest, increasing by 21 percent between

2013 and 2023, and overtaking the North as the largest regional employer for the cluster. This was followed by the South Central subregion which grew by 14 percent. At the same time, employment in the North and North Central subregions declined by 7 and 2 percent, respectively.

Figure 2.5.2 Employment in the Machinery Cluster by Subregion



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

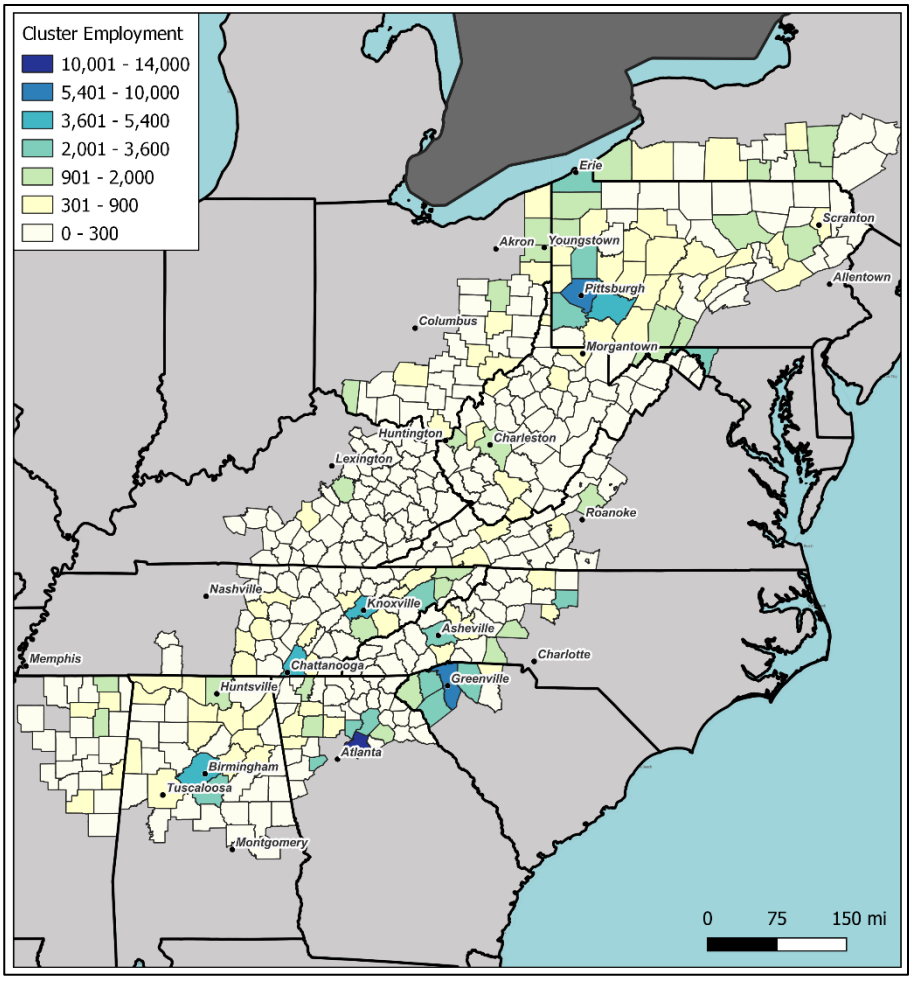
Three counties make up 16 percent of the cluster's total employment in Appalachia:

- Gwinnett County, GA (in the Greater Atlanta area) with 13,200 employees
- Greenville County, SC (including the city of Greenville and located near Inland Port Greer[10]) with 10,000 employees
- Allegheny County, PA (which includes the city of Pittsburgh) with 8,400 employees

In some smaller counties, machinery accounts for a large share of total employment. In Fulton County, PA, 29 percent of all jobs fall under the machinery cluster (1,350 total jobs). In Morgan County, OH, 19 percent of all jobs in the county are in machinery (450 jobs).

[10] For more information on the inland port, see https://scspa.com/facilities/inland-port-greer/.

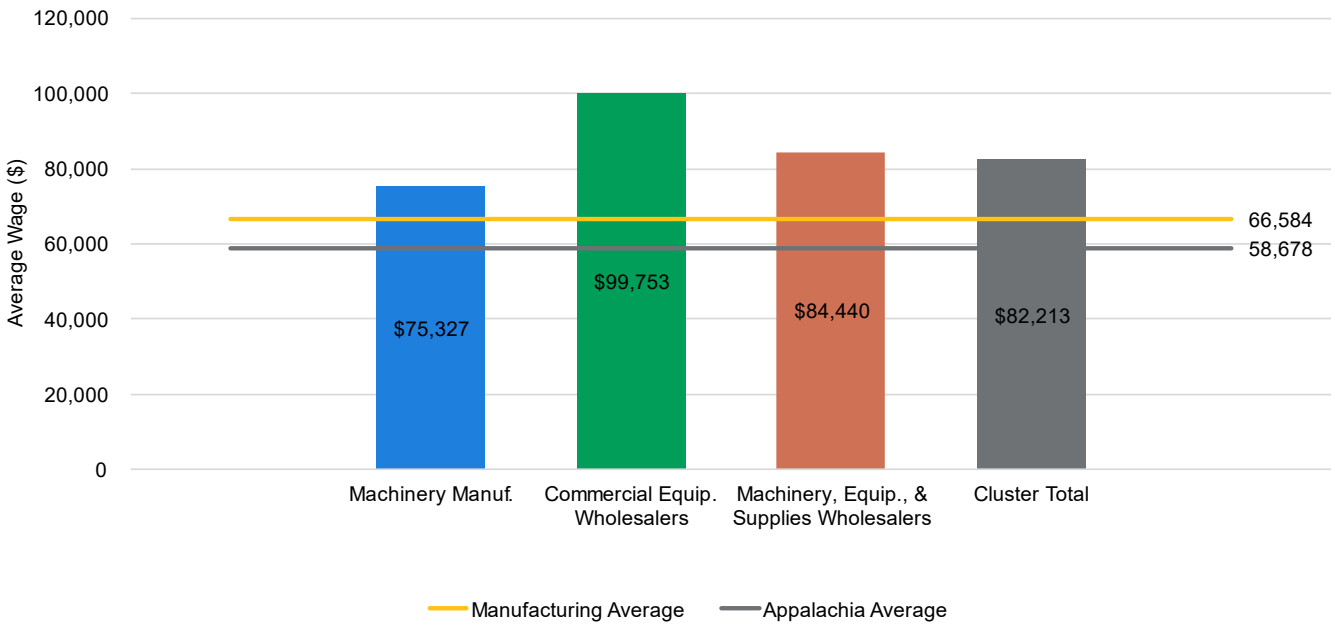
Figure 2.5.3 Machinery Employment Concentrations by County, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the machinery cluster vary by industry but are consistently higher than the average wage in the region, which is about $59,000. Commercial equipment wholesalers earn the highest wages (almost $100,000) followed by machinery equipment and supplies wholesalers ($84,000) and machinery manufacturers ($75,000).

Figure 2.5.4 Wages in the Machinery Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.5.3 Export Activity and Key Ports

Of the $117 billion of machinery produced in Appalachia in 2022, $85 billion (73 percent) was shipped outside of the region and $13 billion (12 percent) was exported to other countries. Machinery manufacturing is the largest of the cluster's four industries, with $77 billion in output in Appalachia in 2022 and 67 percent of the cluster's exports. In 2022, the South subregion produced and exported the most machinery products ($44 billion produced and $5 billion exported).

Table 2.7 Machinery Outbound and Export Value and Intensity, 2022

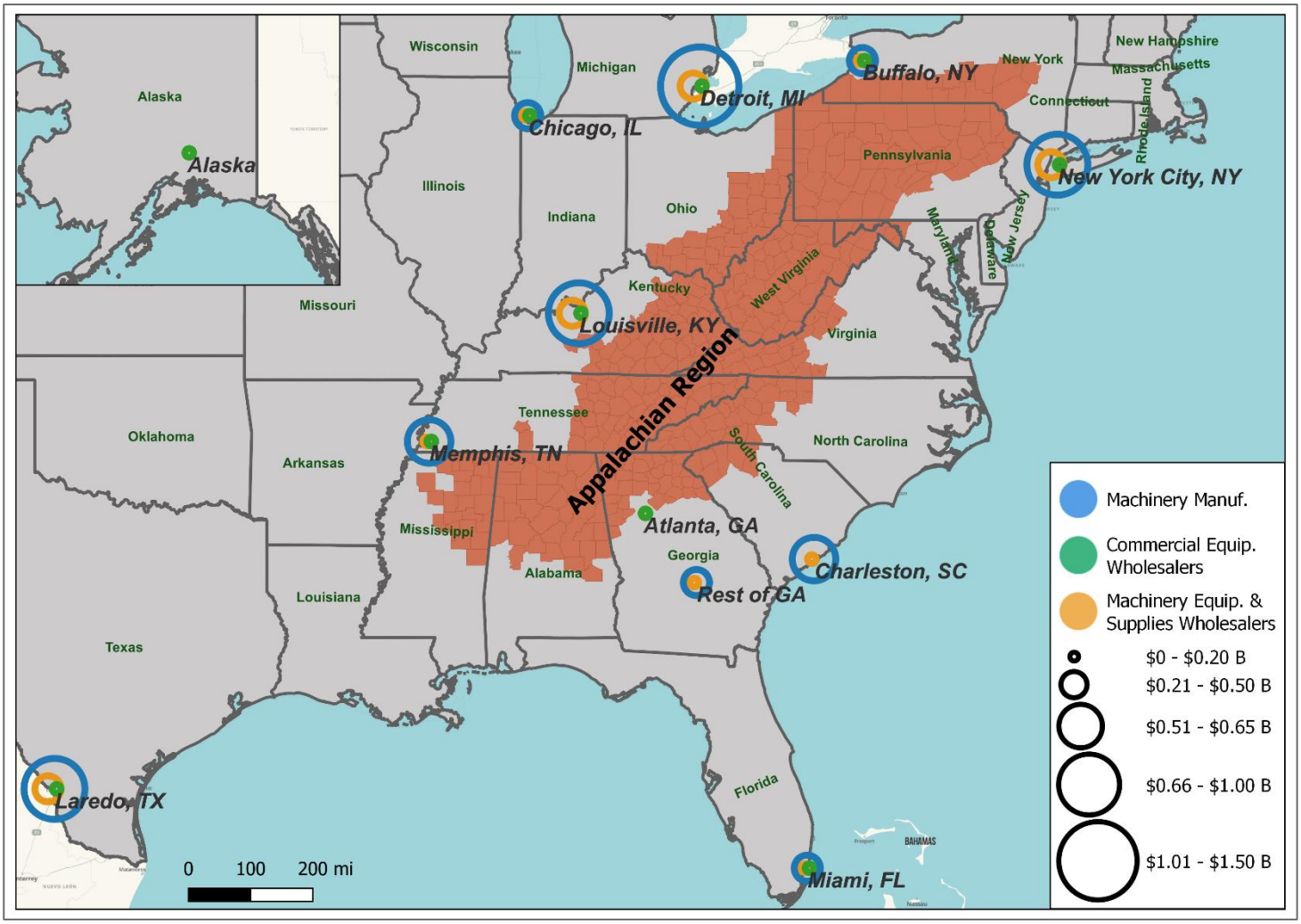
	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Machinery	$116.9	$84.9	$13.5	73%	12%
By Industry					
Machinery Manuf.	$76.8	$55.9	$9.0	73%	12%
Commercial Equip. Wholesalers	$13.0	$9.4	$1.5	72%	11%
Machinery, Equip., & Supplies Wholesalers	$27.1	$19.7	$3.0	73%	11%
By Region					
North	$35.7	$28.2	$3.5	79%	10%
North Central	$10.0	$7.9	$1.8	79%	18%
South Central	$27.0	$23.4	$3.2	87%	12%
South	$44.3	$33.5	$5.1	76%	12%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Exports from equipment wholesalers increased by 24 percent since 2017. In contrast, the machinery manufacturing and machinery equipment and supplies wholesaler industries both experienced a 15 percent decline in exports in 2020, the year of the Covid-19 pandemic, and have not recovered to pre-pandemic levels.

Ports of exit for Appalachia's machinery products are spread throughout much of the United States and include water ports such as New York City, NY and Charleston, SC, trucking ports such as Laredo, TX and Detroit, MI, and airports in Memphis, TN and Louisville, KY.

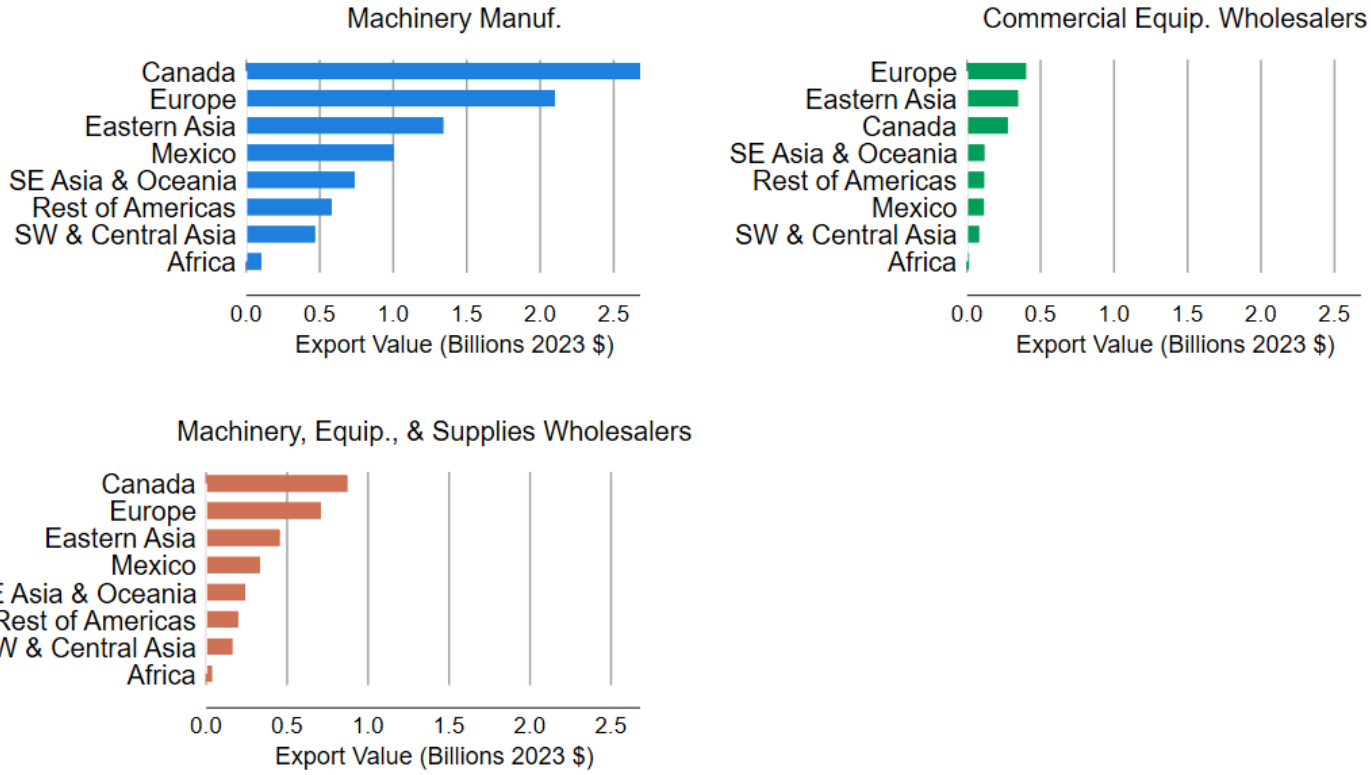
Figure 2.5.5 Top Ports of Exit for the Machinery Cluster by Industry, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Rings are offset from port centroids so each industry's ring is visible.

Canada is the largest importer of Appalachia's machinery products, totaling $3.8 billion in 2022, followed by Europe with $3.2 billion. Together, these two areas are the destination for over half of Appalachia's machinery exports.

Figure 2.5.6 Machinery Cluster Export Destinations, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.5.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, most machinery is shipped by truck (63 percent). The next most common mode is via air, which accounts for 27 percent of machinery en route to a port of exit.

From the port of exit to the final destination, machinery products are transported most frequently by air (41 percent of the cluster's total export value). Truck is also a common mode for all machinery industries, particularly for exports shipped to Mexico and Canada, and is used to transport about one third of the cluster's products.

Table 2.8 Machinery Cluster Export Mode from Appalachia, 2022

Machinery Manuf.			Commercial Equip. Wholesalers			Machinery, Equip., & Supplies Wholesalers		
Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports
Air (including truck-air)	$3.51	39%	Air (including truck-air)	$0.90	61%	Air (including truck-air)	$1.10	37%
Truck	$3.12	35%	Truck	$0.32	22%	Truck	$1.02	34%
Water	$2.09	23%	Water	$0.23	16%	Water	$0.77	26%
Rail	$0.27	3%	Multiple modes & mail	$0.01	<1%	Rail	$0.09	3%
Multiple modes & mail	$0.03	<1%	Rail	$0.00	<1%	Multiple modes & mail	$0.01	<1%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.6. Metals and Minerals

2.6.1 Cluster Overview

306,000
employees in 2023

$71,000
average wage in 2023

$161 billion
cluster output in 2022

$3.7 billion
exports to Europe in 2022

4%
growth in employment over the last 10 years

$12,000
higher than the average wage in Appalachia

$13 billion
total exports in 2022

46%
export value shipped via air in 2022

The metals and minerals cluster is made up of four industries:

- **Nonmetallic Mineral Product Manufacturing** (NAICS 327) which involves transforming mined or

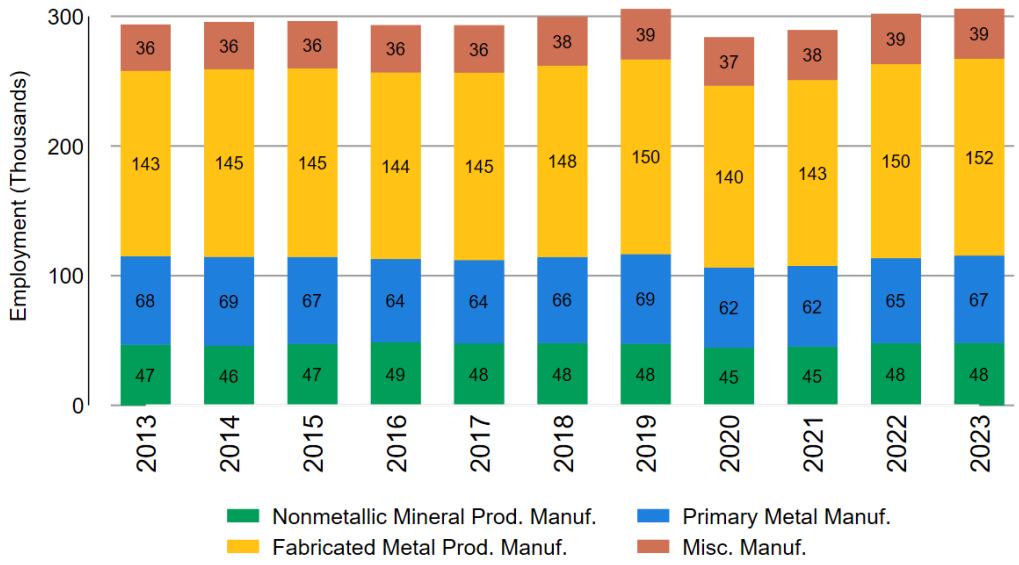
quarried materials like sand, stone, and clay into products for intermediate or final consumption.

- **Primary Metal Manufacturing** (NAICS 331) which includes processes such as smelting and refining and the production of metal alloys and basic metal products like strips, sheets, bars, rods, and wires.
- **Fabricated Metal Product Manufacturing** (NAICS 332) which involves transforming metal into intermedial or final products through forging, stamping, welding, or assembling.
- **Miscellaneous Manufacturing** (NAICS 339) which covers a wide range of manufacturing activities but is included in this cluster due to its inclusion of melting and shaping of precious metals to make jewelry and the bending forming and assembly used in making medical products.

2.6.2 Employment and Wages

In 2023, the metals and minerals cluster employed 306,000 people in Appalachia – the largest of the seven export-oriented industry clusters. The fabricated metals products manufacturing industry accounts for about half of the cluster's total employment in the region and grew by 6 percent over the last decade. In contrast, employment in the primary metal manufacturing industry saw a small (1 percent) decline during that period.

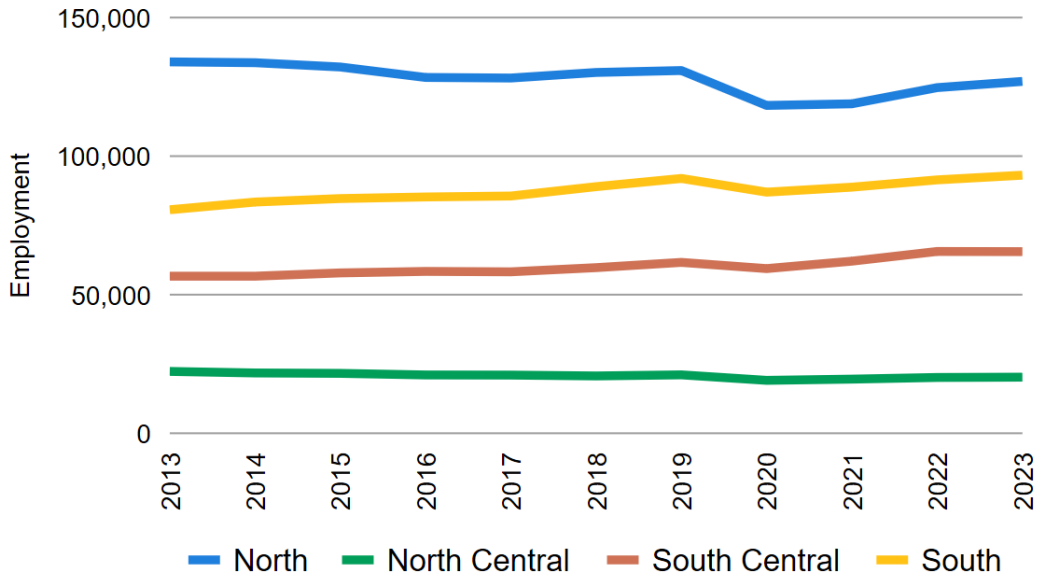
Figure 2.6.1 Employment in the Metals and Minerals Cluster by Industry



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

About 42 percent of the region's employment in the metals and minerals cluster is in the North subregion (127,000 workers). However, that subregion experienced a 5 percent decline in employment over the last decade (exacerbated by the Covid-19 pandemic in 2020) while the South and South Central subregions each grew by over 15 percent.

Figure 2.6.2 Employment in the Metals and Minerals Cluster by Subregion



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

In general, employment in the metals and minerals cluster is prevalent throughout the North, South Central and South subregions, with particularly high levels of employment in the following areas:

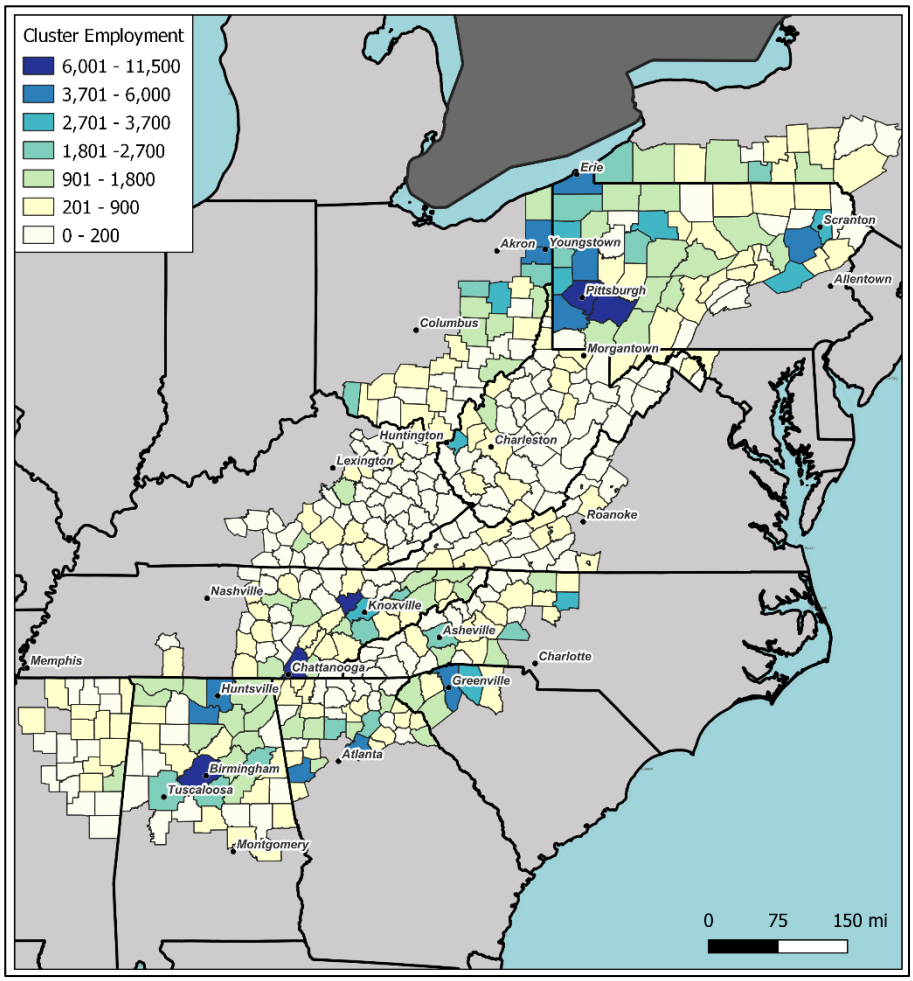
- Allegheny County, PA (which includes the city of Pittsburgh) and Westmoreland County, PA (in the Greater Pittsburgh Area) with 11,300 and 6,700 employees, respectively
- Jefferson County, AL (which includes the city of Birmingham) with 10,400 employees
- Anderson County, TN (in the Greater Knoxville Area) with 9,000 employees and making up 22 percent of the county's total jobs

Some smaller metro areas also have concentrations of employment in metal and minerals, such as the Greater Scranton Area, PA with 5,400 employees in Luzerne County and 3,700 in Lackawanna County, Erie County, PA (which includes the city of Erie) with 5,000 employees, and Mahoning County, OH (which includes the city of Youngstown) with 4,900 employees in the cluster.

In some smaller counties, metals and minerals jobs account for a large share of total employment:

- Cameron County, PA where the 500 machinery employees make up 38 percent of the county's jobs
- Van Buren County, TN where the 100 machinery employees make up 35 percent of the county's jobs
- Elk County, PA where the 3,100 machinery employees make up 25 percent of the county's jobs

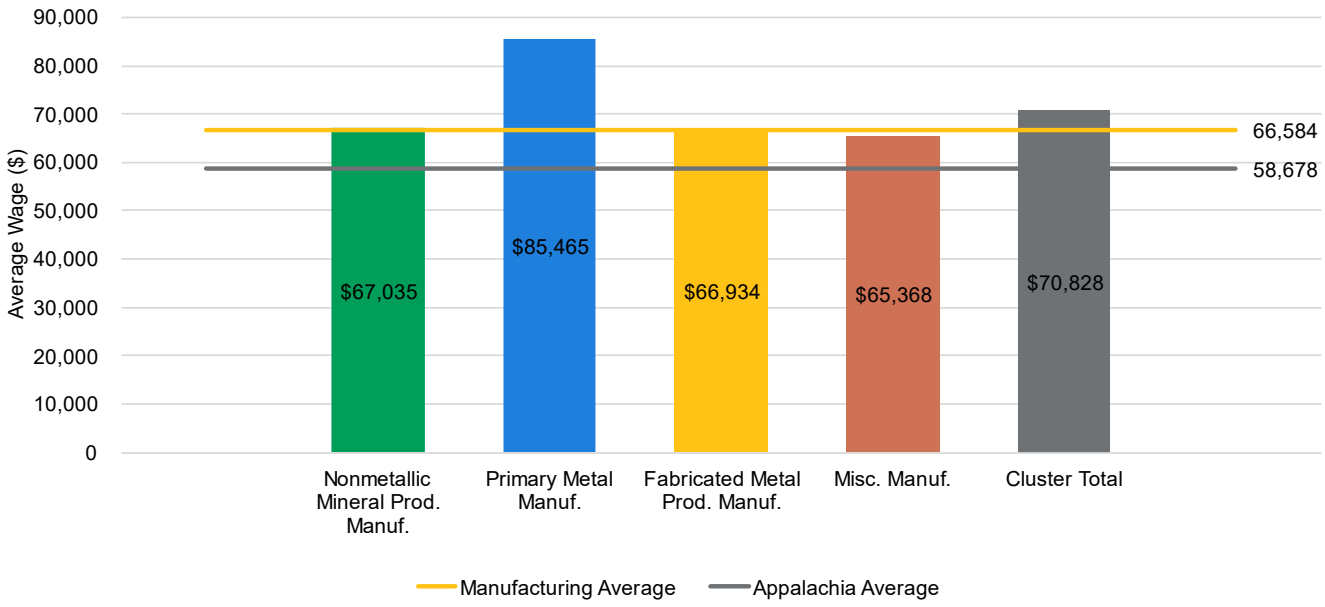
Figure 2.6.3 Metals and Minerals Employment Concentrations by County, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the metals and minerals cluster vary by industry but are generally higher than the average wage in the region. Primary metal manufacturers earn the highest wages ($85,000). Other industries in the cluster earn about $67,000, in line with the average wage for all manufacturing jobs in Appalachia.

Figure 2.6.4 Wages in the Metals and Minerals Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.6.3 Export Activity and Key Ports

Of the $161 billion of metals and minerals produced in Appalachia in 2022, $116 billion (72 percent) was shipped outside of the region and $13 billion (8 percent) was exported to other countries. The primary and fabricated metal manufacturing industries were the largest of the cluster's four industries, together accounting for 67 percent of the cluster's value produced, while miscellaneous manufacturing had the highest export share (12%) with $3.5 billion in exports. The North subregion had the highest production in the cluster in 2022, totaling $65 billion, as well as the highest export value ($5 billion).

Table 2.9 Metals and Minerals Outbound and Export Value and Intensity, 2022

	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Metals & Minerals	$160.7	$116.0	$12.8	72%	8%
By Industry					
Nonmetallic Mineral Prod. Manuf.	$24.2	$17.3	$1.5	72%	6%
Primary Metal Manuf.	$48.5	$34.9	$3.0	72%	6%
Fabricated Metal Prod. Manuf.	$58.7	$42.6	$4.7	73%	8%
Misc. Manuf.	$29.3	$21.1	$3.5	72%	12%
By Region					
North	$65.1	$50.1	$4.5	77%	7%
North Central	$11.7	$9.3	$1.2	80%	10%
South Central	$32.1	$27.4	$2.8	85%	9%
South	$51.8	$40.1	$4.2	77%	8%

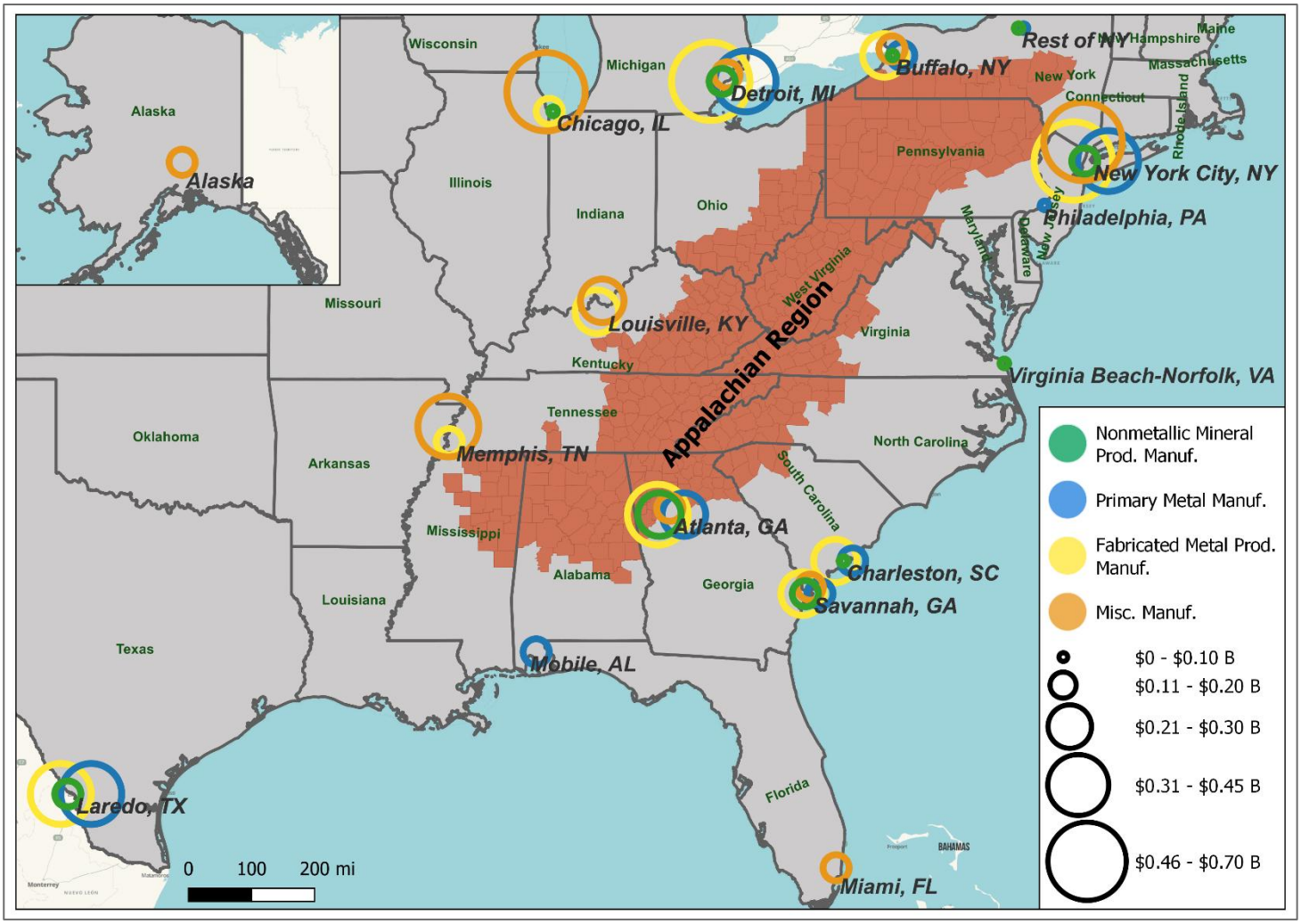
Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Appalachia's exports in the nonmetallic mineral, primary metal, and fabricated metal manufacturing industries peaked in 2018 but have since declined. By 2022, exports from the nonmetallic mineral and fabricated metal manufacturing industries fell by over 16 percent compared to their 2018 values while the primary metal manufacturing industry experienced a 29 percent decline in exports. Exports in miscellaneous manufacturing, on the other hand, continued to grow after 2018 and increased by 27 percent between 2017 and 2022. This broad industry included some activities other than metals and minerals which could be driving that disparity.

Ports of exit for Appalachia's metals and minerals products are spread throughout the United States and include water ports such as New York City, NY, Savannah, GA and Charleston, SC, trucking ports such as Laredo, TX and Detroit, MI, and airports in Memphis, TN, Atlanta, GA, and Louisville, KY.

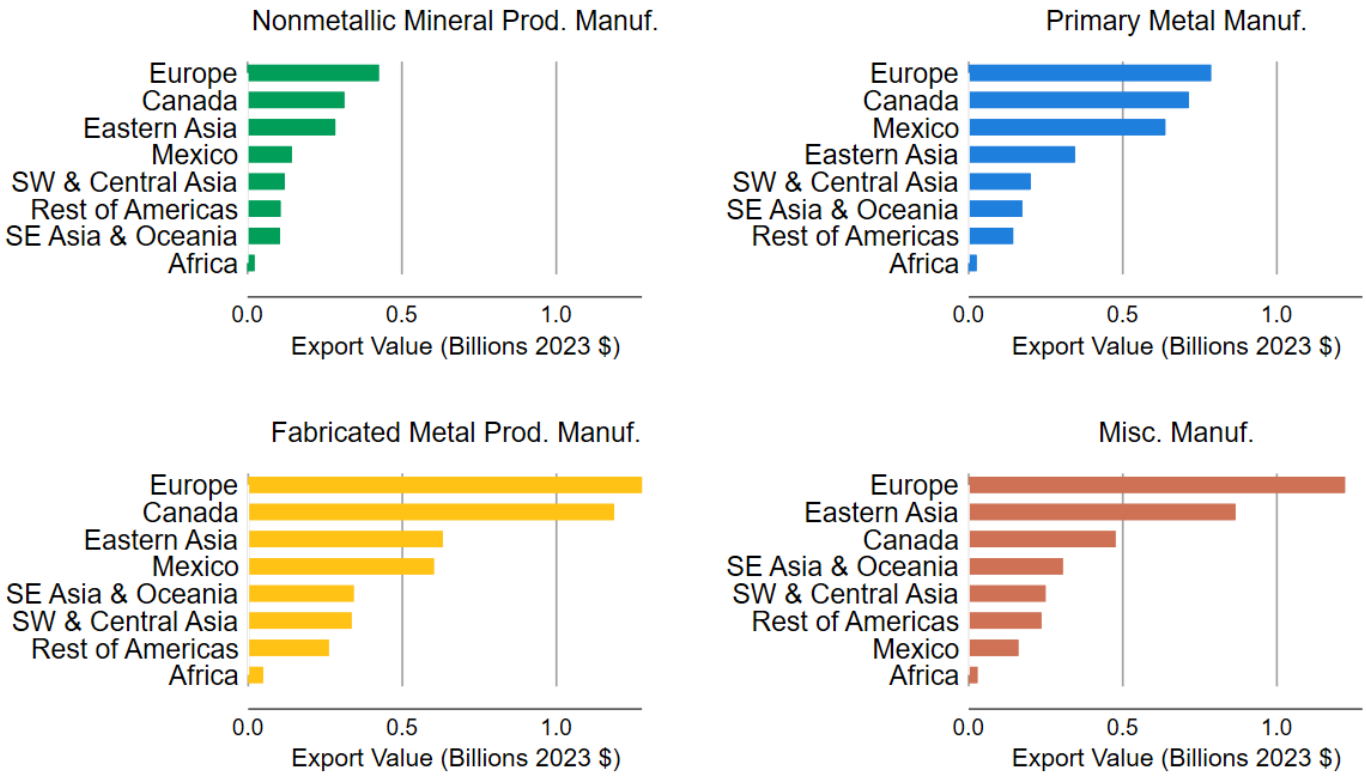
Figure 2.6.5 Top Ports of Exit for the Metals and Minerals Cluster by Industry, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Rings are offset from port centroids so each industry's ring is visible.

In all four of the cluster's industries, Europe is the most common destination for Appalachia's metals and minerals, accounting for over $3.7 billion (29 percent) of the cluster's exports. Canada and Eastern Asia are also frequent destinations for metals and minerals exports, totaling in $2.7 billion and $2.1 billion, respectively in 2022.

Figure 2.6.6 Metals and Minerals Cluster Export Destinations, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.6.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, most metals and minerals products are transported by truck (68 percent). The next most common mode is air, which accounts for 22 percent of metals and minerals value in transit to a port of exit.

From the port of exit to the final destination, the most common mode of transport for metals and minerals varies by industry. Overall, air is the most common mode of transport for the cluster, accounting for 46 percent of total export value. This mode is particularly common for miscellaneous manufacturing products, where 68 percent travel by air. Truck and water are also common modes used to export metals and minerals, accounting for 27 and 24 percent of exported value, respectively.

Table 2.10 Metals and Minerals Cluster Export Mode from Appalachia, 2022

Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports
Nonmetallic Mineral Prod. Manuf.			**Primary Metal Manuf.**		
Water	$0.55	36%	Truck	$1.01	33%
Air (including truck-air)	$0.53	35%	Air (including truck-air)	$0.98	32%
Truck	$0.39	25%	Water	$0.82	27%
Rail	$0.05	3%	Rail	$0.21	7%
Multiple modes & mail	$0.00	<1%	Multiple modes & mail	$0.01	<1%
Fabricated Metal Prod. Manuf.			**Misc. Manuf.**		
Air (including truck-air)	$1.93	41%	Air (including truck-air)	$2.42	68%
Truck	$1.49	32%	Water	$0.58	16%
Water	$1.10	23%	Truck	$0.51	14%
Rail	$0.15	3%	Multiple modes & mail	$0.02	1%
Multiple modes & mail	$0.02	<1%	Rail	$0.01	<1%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.7. Mining

2.7.1 Cluster Overview

48,000
employees in 2023

$96,000
average wage in 2023

$88 billion
cluster output in 2022

$3.4 billion
exports to Europe in 2022

-29%
decline in employment over the last 10 years

$37,000
higher than the average wage in Appalachia

$8 billion
total exports in 2022

92%
exported via water ports in 2022

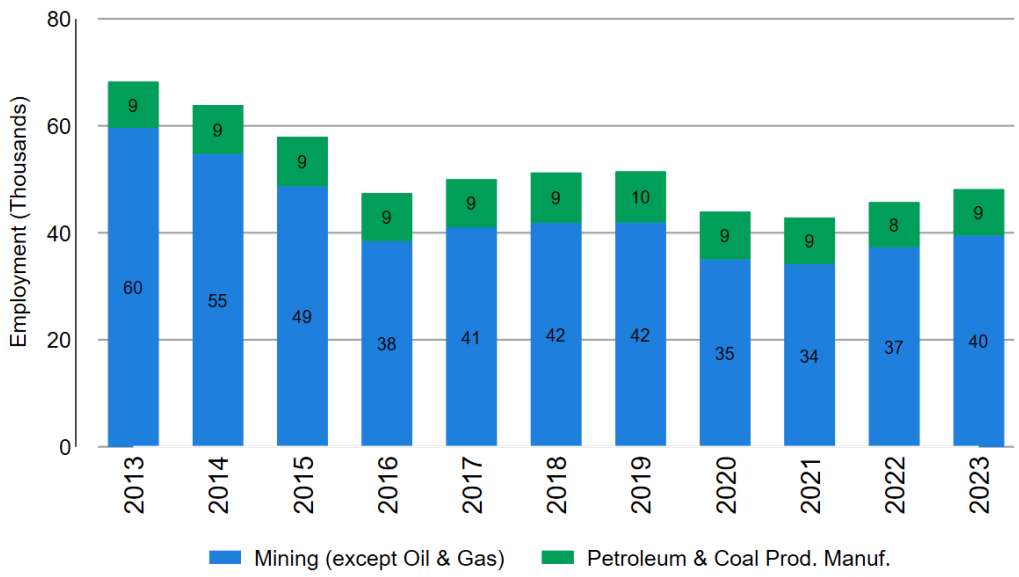
The mining cluster is made up of two industries:

- **Mining (except Oil and Gas)** (NAICS 212) which includes mining and preparing minerals including coal, metal ore, and nonmetallic minerals.
- **Petroleum and Coal Products Manufacturing** (NAICS 324) which involves transforming crude petroleum and coal into usable products such as asphalt and lubricating oils.

2.7.2 Employment and Wages

In 2023, the mining cluster employed 48,000 people in Appalachia, substantially lower than the 68,000 employed a decade before. This loss in employment was entirely borne by the mining industry, which declined from 59,600 employees in 2013 to 39,500 in 2023. The petroleum and coal products manufacturing industry remained more constant over the period, fluctuating between 8,400 and 9,500 jobs in Appalachia.

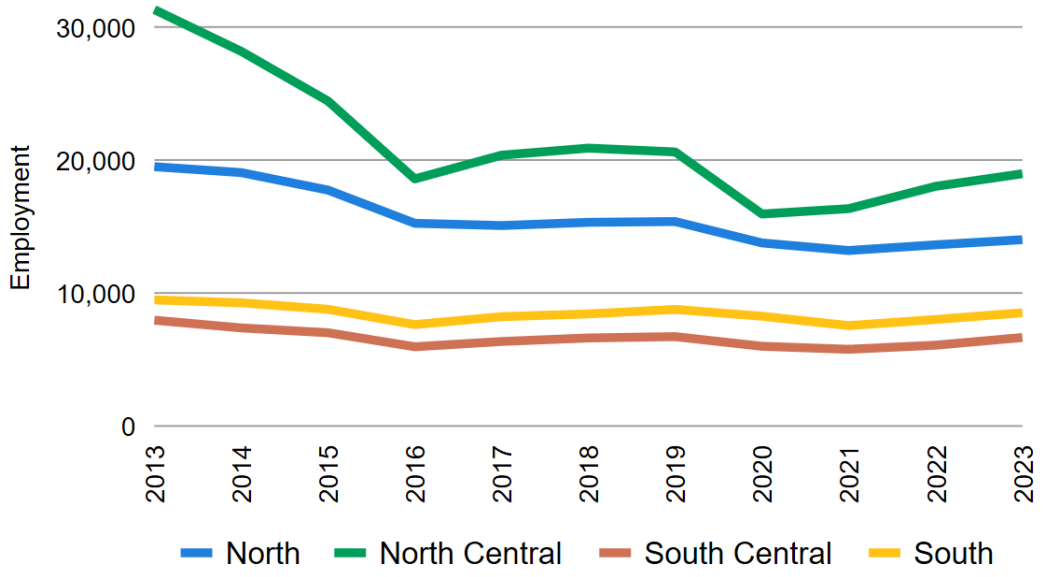
Figure 2.7.1 Employment in the Mining Cluster by Industry



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

Despite having a substantially smaller population than other subregions, the North Central subregion has the highest employment in mining due to its abundance of coal. While all parts of Appalachia experienced a decline in mining employment, the North Central subregion was the hardest hit, losing 39 percent of employees in the cluster.

Figure 2.7.2 Employment in the Mining Cluster by Subregion



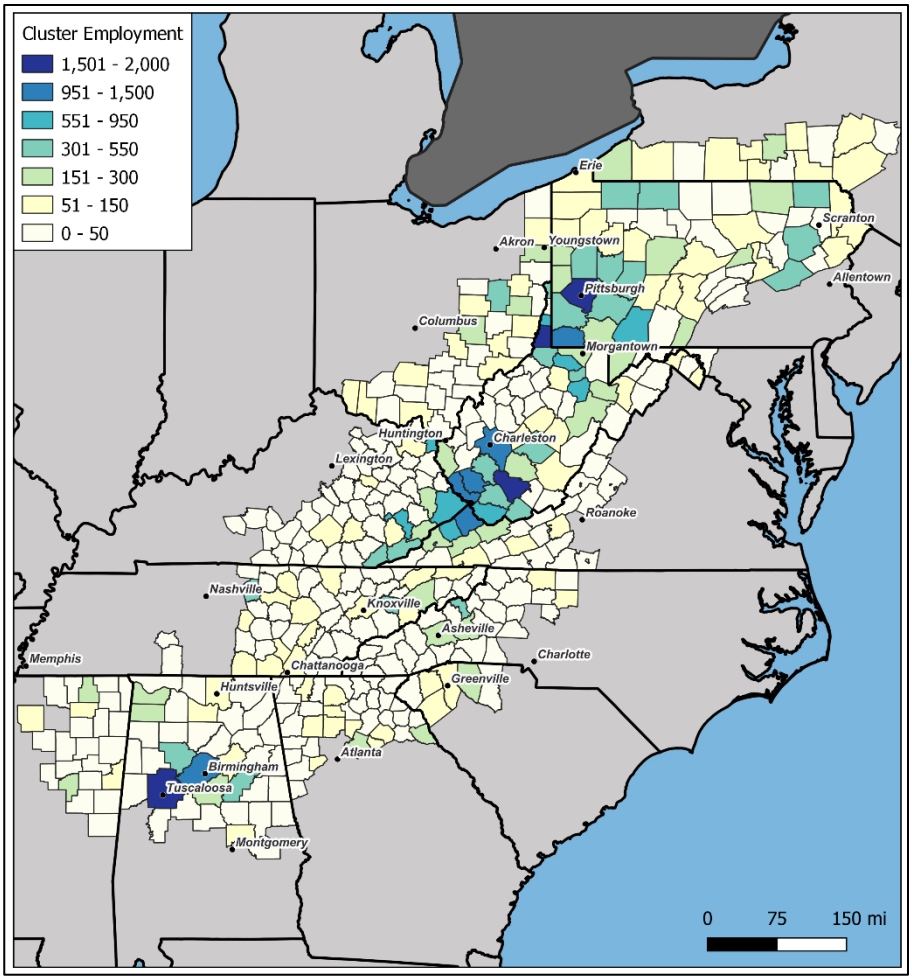
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

In Appalachia, employment in the mining cluster is concentrated in West Virginia, Alabama, and Pennsylvania. Together, the Appalachian portion of these three states accounts for 65 percent of the total cluster employment in the region. Within these states, several counties have particularly high mining employment:

- Raleigh County, WV with 2,100 employees
- Tuscaloosa County, AL (which includes the city of Tuscaloosa) with 1,800 employees
- Allegheny County, PA (which includes the city of Pittsburgh) with 1,600 employees

Mining is also a cornerstone of the economy of some relatively small counties. In Buchanan County and Dickenson County, two small counties in Virginia, mining accounts for about a quarter of total jobs. In three West Virginia Counties, McDowell, Mingo, and Barbour, mining makes up 23 percent of total jobs.

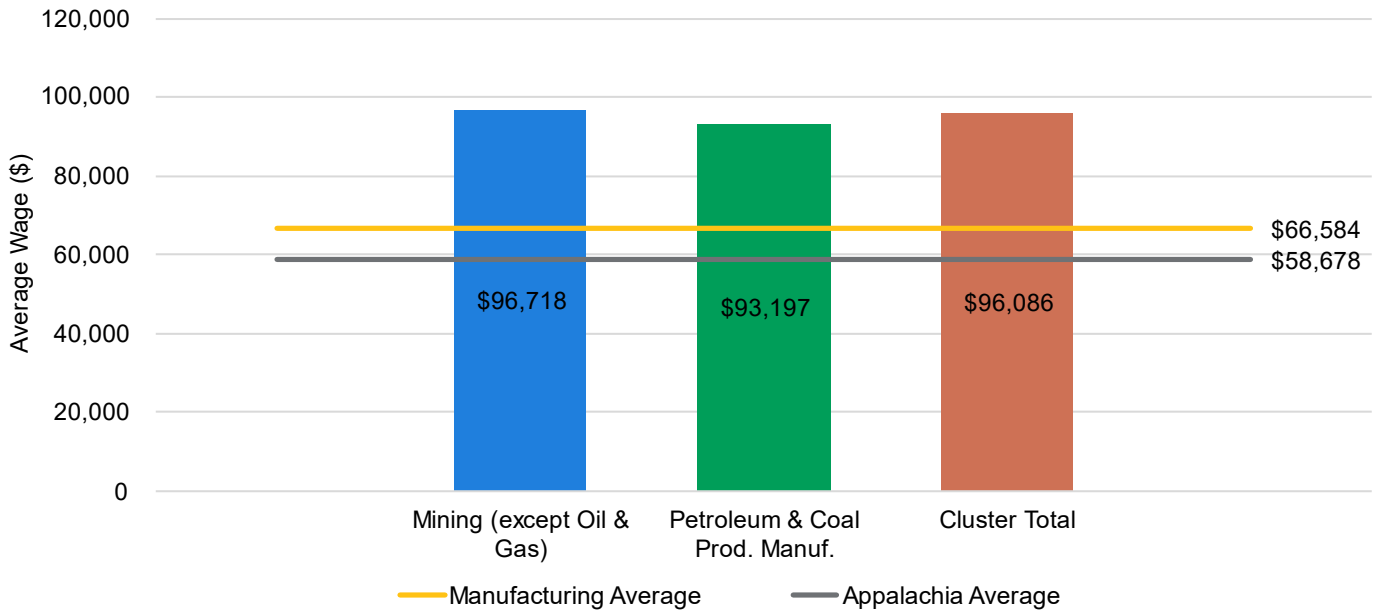
Figure 2.7.3 Mining Employment Concentrations by County, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the mining industry in Appalachia averaged about $96,000 in 2023, substantially higher than the average wage in the region ($59,000).

Figure 2.7.4 Wages in the Mining Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.7.3 Export Activity and Key Ports

Of the $88 billion of mining products produced in Appalachia in 2022, $44 billion (50 percent) was shipped outside of the region and $8 billion (9 percent) was exported to other countries. Despite accounting for only 18 percent of the cluster's employment in 2022, petroleum and coal product manufacturing was the larger of the cluster's two industries in terms of value produced, totaling $65 billion. Mining, however, has a much larger export share than for petroleum and coal products manufacturing, and as a results exports more than two times as much (by value). The North Central subregion exports the highest value of mining products ($3.6 billion) with Appalachia's high-quality coal products still in demand internationally.

Table 2.11 Mining Outbound and Export Value and Intensity, 2022

	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Mining	$87.8	$44.3	$8.3	50%	9%
By Industry					
Mining (except Oil & Gas)	$23.2	$14.8	$5.9	64%	25%
Petroleum & Coal Prod. Manuf.	$64.6	$29.5	$2.4	46%	4%
By Region					
North	$26.9	$15.8	$1.7	58%	6%
North Central	$23.9	$12.4	$3.6	52%	15%
South Central	$14.1	$7.7	$0.6	55%	4%
South	$23.0	$13.0	$2.4	57%	11%

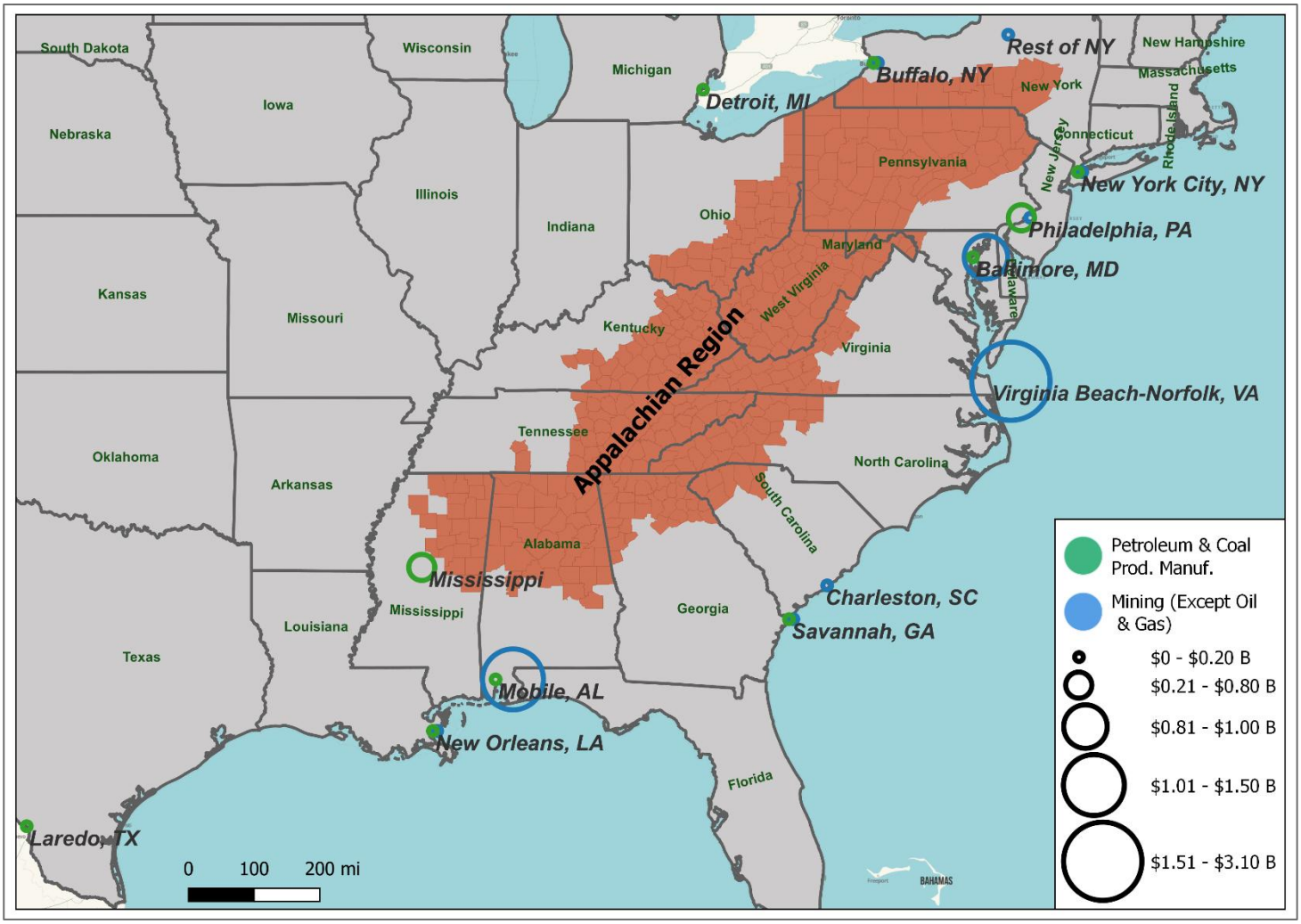
Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Cluster exports peaked at $11 billion in 2018 before declining to a low of $6 billion in 2020. Since then, the cluster recovered to an export value of $8 billion in 2022. This volatility is driven by the mining industry which increased by 26 percent between 2017 and 2018 before dropping by 56 percent between 2018 and 2020.

Over $3 billion of Appalachia's exports in the mining (except oil and gas) industry moved through Virginia Beach-Norfolk, VA, accounting for over half of the industry's total exports from the region. Mobile, AL was the port of exit for another 20 percent, or $1.2 billion of mining products. For petroleum and coal, Philadelphia and Mississippi[11] are the main ports of exit and each account for over 25 percent of the industry's exports from Appalachia. About $1.1 billion from the mining cluster was exported through Baltimore, MD in 2022. The collapse of the Francis Scott Key Bridge in 2024 temporarily disrupted the operations of this port of exit (though at the time of this report no data for 2024 are available), with the bridge collapse interrupting all freight service through the Port of Baltimore for several months in early 2024.

[11] FAF data are only available for the entire state of Mississippi and do not provide information on sub-state freight flows.

Figure 2.7.5 Top Ports of Exit for the Mining Cluster by Industry, 2022



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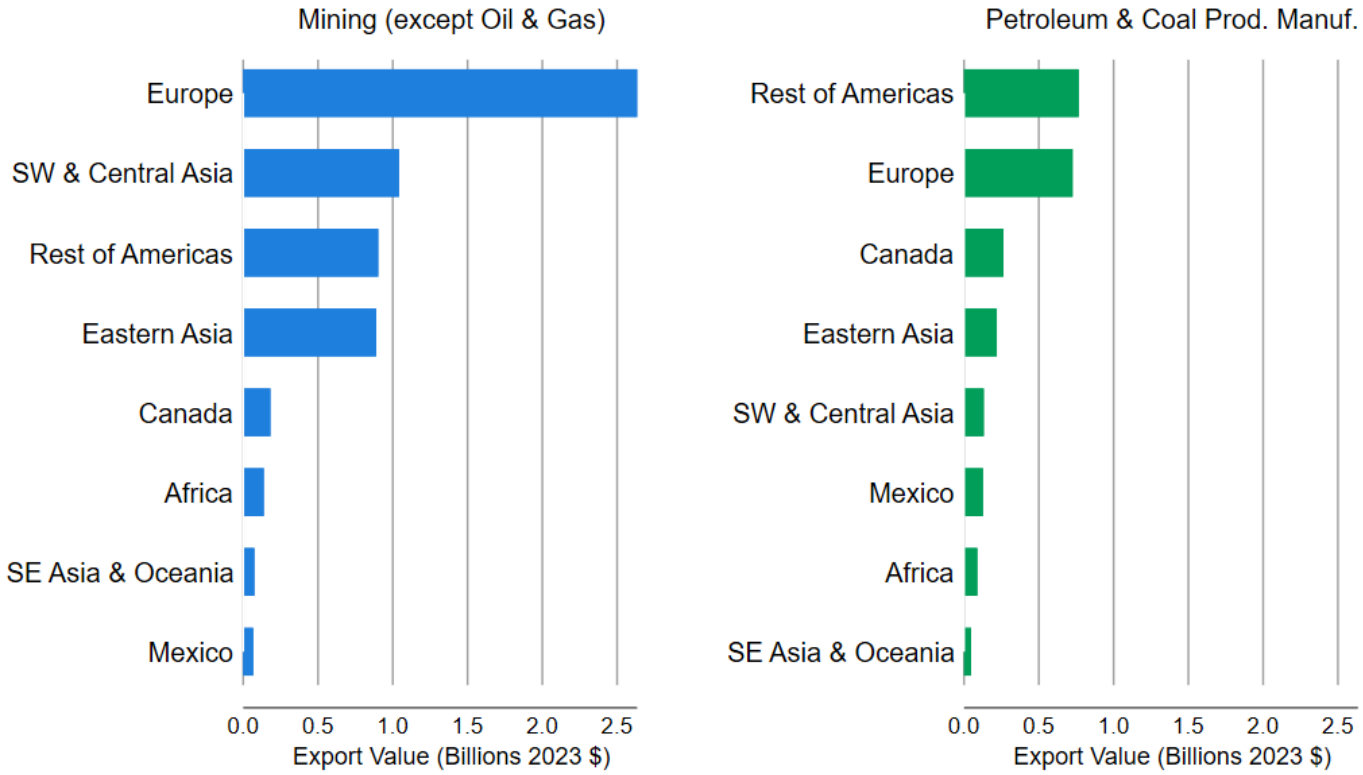
Note: Rings are offset from port centroids so each industry's ring is visible.

In 2022, $2.6 billion worth of exports in mining (except oil and gas) were shipped to Europe, accounting for 44 percent of Appalachia's total exports in the industry. The petroleum and coal products industry, which exports less value than the mining industry, most frequently ships goods to the rest of the Americas and Europe.

Figure 2.7.6 Mining Cluster Export Destinations, 2022



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Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.7.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, the majority of mining products are shipped by truck (72 percent worth $4.2 billion) while petroleum and coal are shipped by both rail (43 percent worth $1.0 billion) and truck (41 percent worth $1.0 billion).

From the port of exit to the final destination, mining products are almost exclusively transported by water (92 percent of the cluster's total export value).

Table 2.12 Mining Cluster Export Mode from Appalachia, 2022

Mining (except Oil & Gas)			Petroleum & Coal Prod. Manuf.		
Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports
Water	$5.73	97%	Water	$1.89	80%
Air (including truck-air)	$0.11	2%	Truck	$0.25	10%
Truck	$0.06	1%	Air (including truck-air)	$0.14	6%
Rail	$0.02	<1%	Rail	$0.09	4%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.8. Transportation Equipment and Vehicles

2.8.1 Cluster Overview

230,000 employees in 2023

$70,000 average wage in 2023

$184 billion cluster output in 2022

$7 billion exports to Europe in 2022

29% growth in employment over the last 10 years

$11,000 higher than the average wage in Appalachia

$24 billion total exports in 2022

50% exported value shipped via water ports in 2022

The transportation equipment and vehicles cluster is made up of two industries:

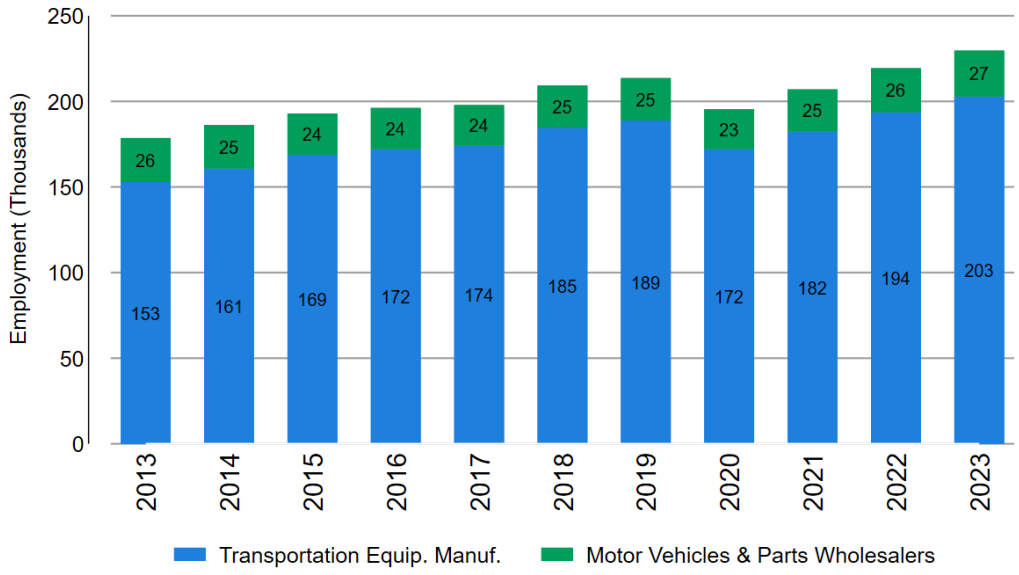
- **Transportation Equipment Manufacturing** (NAICS 336) which covers the production of any equipment used to transport people or goods via road, air, or water (including motor vehicle manufacturing).
- **Motor Vehicles and Parts Wholesalers** (NAICS 4231) which covers the distribution of automobiles,

other motor vehicles, supplies, tires, and other part.

2.8.2 Employment and Wages

In 2023, the transportation equipment and vehicles cluster employed 230,000 people in Appalachia, a 29 percent increase from the 153,000 employed 10 years previously. This growth was driven by the transportation equipment manufacturing industry, which grew by almost 50,000 employees between 2013 and 2023 to over 200,000 jobs.

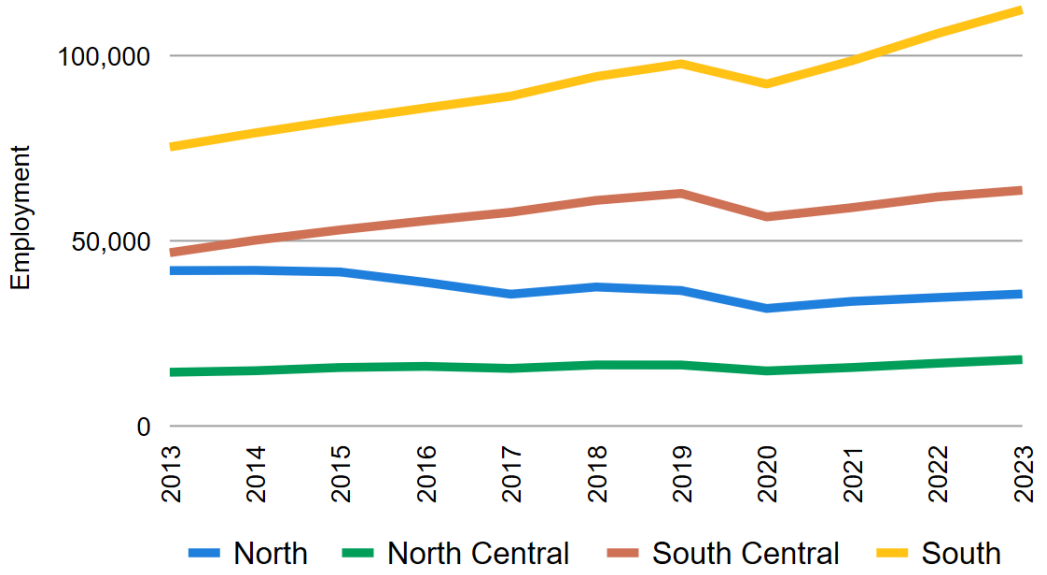
Figure 2.8.1 Employment in the Transportation Equipment and Vehicles Cluster by Industry



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/ and the Bureau of Transpiration Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

Almost half of the region's employment in the transportation equipment and vehicles cluster was in the South subregion in 2023 (112,000 workers). Employment in this cluster is driven in large part by major automotive assembly plants located in the subregion, including the BMW Group Plant in Spartanburg, SC (the world's largest BMW factory), the Mazda Toyota Manufacturing, U.S.A., Inc. plant in Huntsville, AL (Madison County), and Volkswagen's Chattanooga Assembly Plant in Chattanooga, TN (Hamilton County), among facilities for other brands including Mercedes-Benz, Honda, Hyundai, Nissan, Volvo, and General Motors. Over the last decade, transportation equipment and vehicles employment in that subregion grew by 49 percent. The South Central subregion also experienced rapid growth in employment, increasing by 36 percent over the period. Alternatively, employment in the North subregion declined by 15 percent.

Figure 2.8.2 Employment in the Transportation Equipment and Vehicles Cluster by Subregion



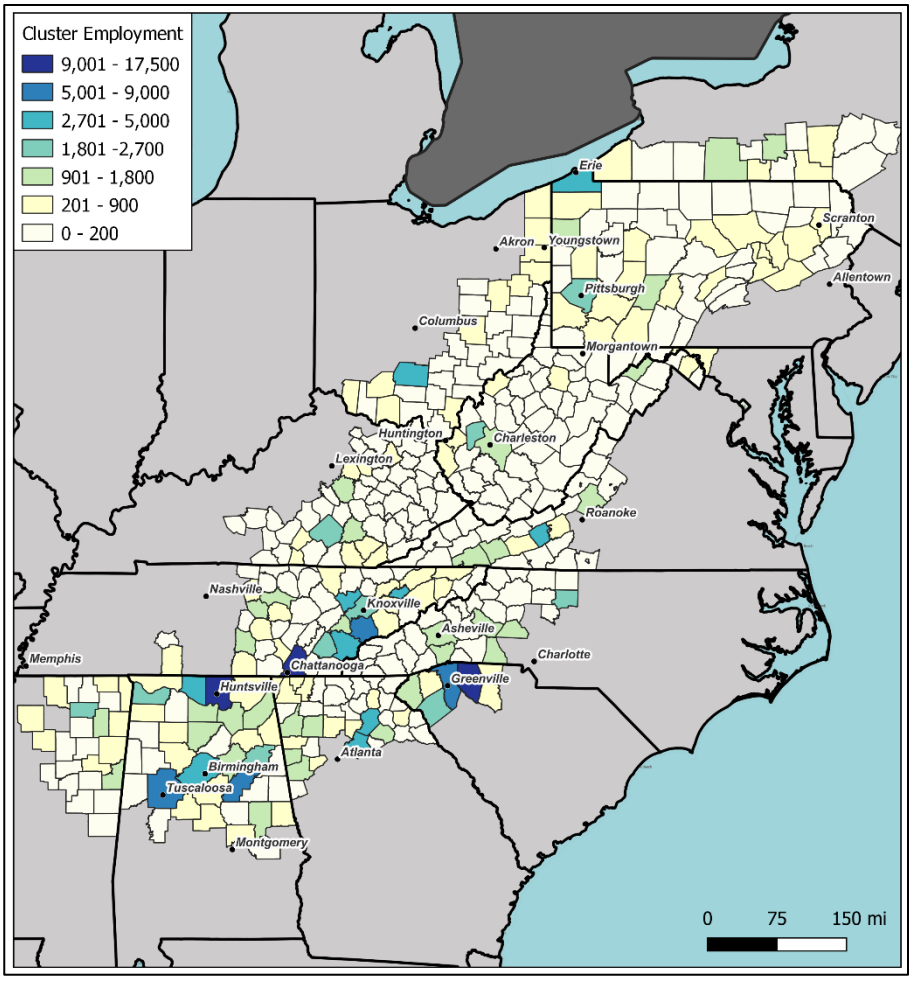
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

In general, employment in the transportation equipment and vehicles cluster is concentrated in the South and South Central subregions of Appalachia, with particularly high levels of employment in the following areas:

- Spartanburg County, SC with 17,200 employees and making up 13 percent of the county's total jobs
- Madison County, AL with 14,700 employees
- Hamilton County, TN with 9,100 employees

The transportation equipment and vehicles cluster accounts for over a quarter of all jobs in Pulaski County, VA (29 percent), Monroe County, TN (29 percent), and DeKalb County, TN (27 percent).

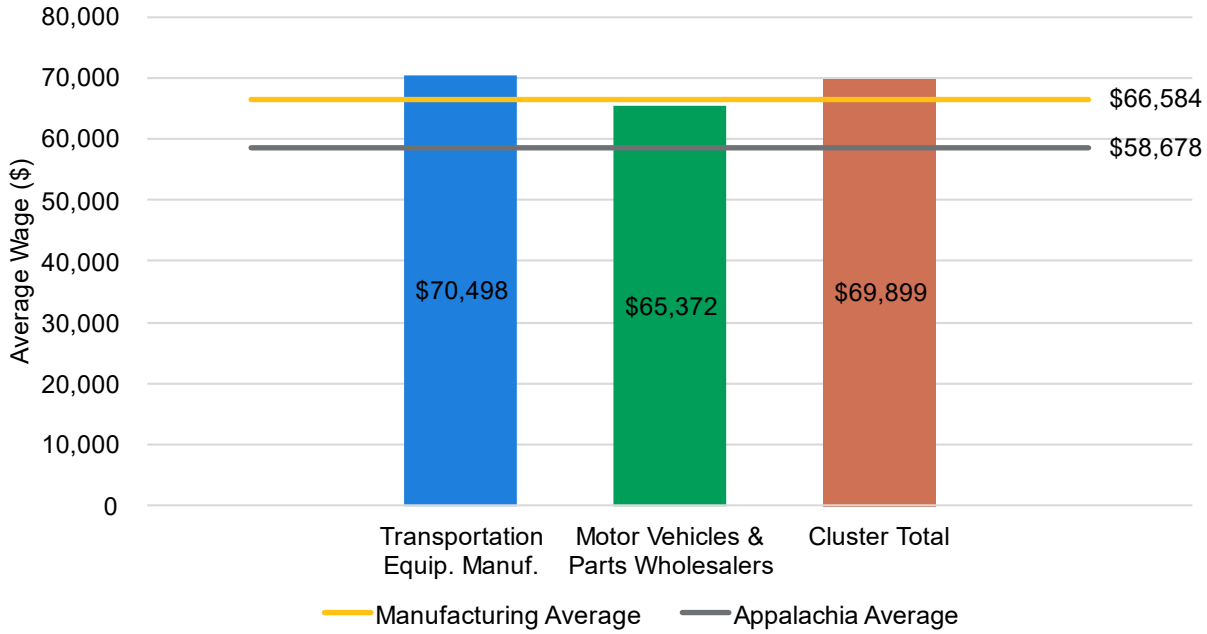
Figure 2.8.3 Transportation Equipment and Vehicles Employment Concentrations by County, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.

Wages in the transportation equipment and vehicles cluster are generally in line with the average manufacturing job in Appalachia. In 2023, transportation equipment manufacturing jobs paid $70,000 while motor vehicles and parts wholesalers earned $65,000 per job.

Figure 2.8.4 Wages in the Transportation Equipment and Vehicles Cluster in Appalachia and Comparison, 2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/.
Note: Bars show average wages for individual industries in Appalachia and the cluster overall. The comparison lines show average wages for all manufacturing jobs in Appalachia and all jobs in Appalachia.

2.8.3 Export Activity and Key Ports

Of the $184 billion of transportation equipment and vehicles products output in Appalachia in 2022, $130 billion (71 percent) was shipped outside of the region and $23.5 billion (13 percent) was exported to other countries. Transportation equipment manufacturing is the larger of the cluster's two industries, totaling $164 billion in value produced in 2022. The South subregion produced 56 percent of the Appalachia's total transportation equipment and vehicles output in 2022, totaling $103 billion.

Table 2.13 Transportation Equipment and Vehicles Outbound and Export Value and Intensity, 2022

	Total Value Produced ($ Billions)	Outbound Value ($ Billions)	Export Value ($ Billions)	Outbound Share	Export Share
Cluster Total					
Transportation Equipment and Vehicles	$183.7	$130.2	$23.5	71%	13%
By Industry					
Transportation Equip. Manuf.	$164.4	$116.8	$21.5	71%	13%
Motor Vehicles & Parts Wholesalers	$19.4	$13.4	$2.0	69%	10%
By Region					
North	$33.4	$27.2	$3.5	81%	10%
North Central	$12.6	$10.4	$1.6	83%	12%
South Central	$34.4	$28.7	$3.2	84%	9%
South	$103.4	$73.0	$15.3	71%	15%

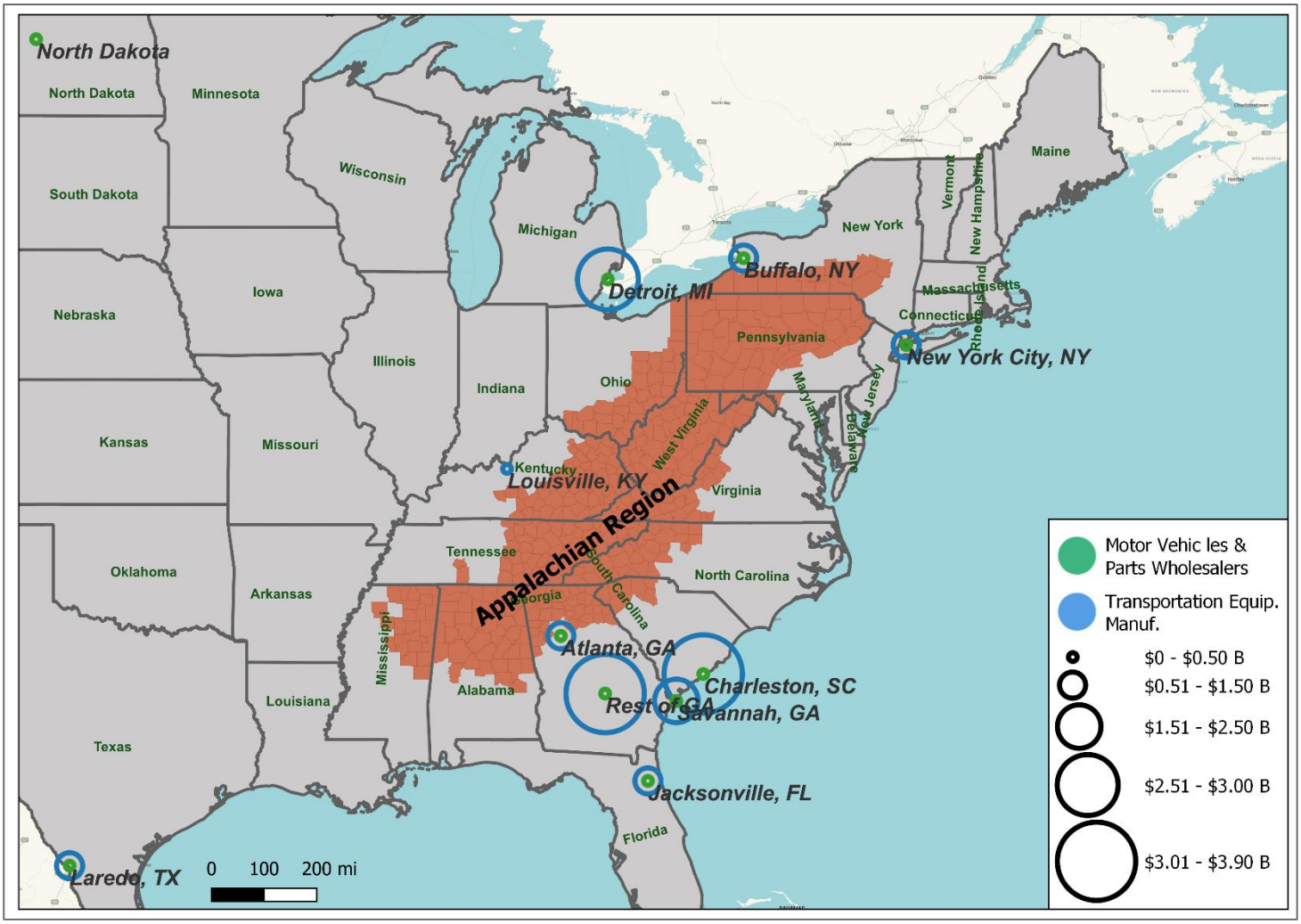
Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

Note: Values converted to real 2023 dollars using the CPI. The total outbound value by subregion does not add up to the Appalachia total due to trade between subregions.

Between 2017 and 2019, leading up to the Covid-19 pandemic, the transportation equipment manufacturing industry experienced 18 percent growth in exports from Appalachia, reaching $28 billion. In 2020, the industry's export value fell to under $18 billion, a 36 percent decline. By 2022, exports from the industry showed signs of recovery, increasing to $22 billion, but still far below its pre-pandemic value. Motor vehicle and parts wholesalers were less impacted by the pandemic and had a relatively constant export value of about $2 billion during the period.

The transportation equipment and vehicles cluster, which is concentrated in the South, takes advantage of several ports of exit in South Carolina, Georgia, and Florida. These ports are in large part connected to nearby automotive manufacturing plants – for example, the Spartanburg BMW plant is in proximity to Inland Port Greer, and thus linked to the port of Charleston, SC; similarly, the Volkswagen plant in Tennessee may rely on nearby ports in Georgia. About 42 percent (over $10 billion) of Appalachia's transportation equipment and vehicles exports move through these three states on the way to their final destination. Given that Canada is a key trading partner for the cluster (see below) Detroit, MI and Buffalo, NY are also key ports of exit.

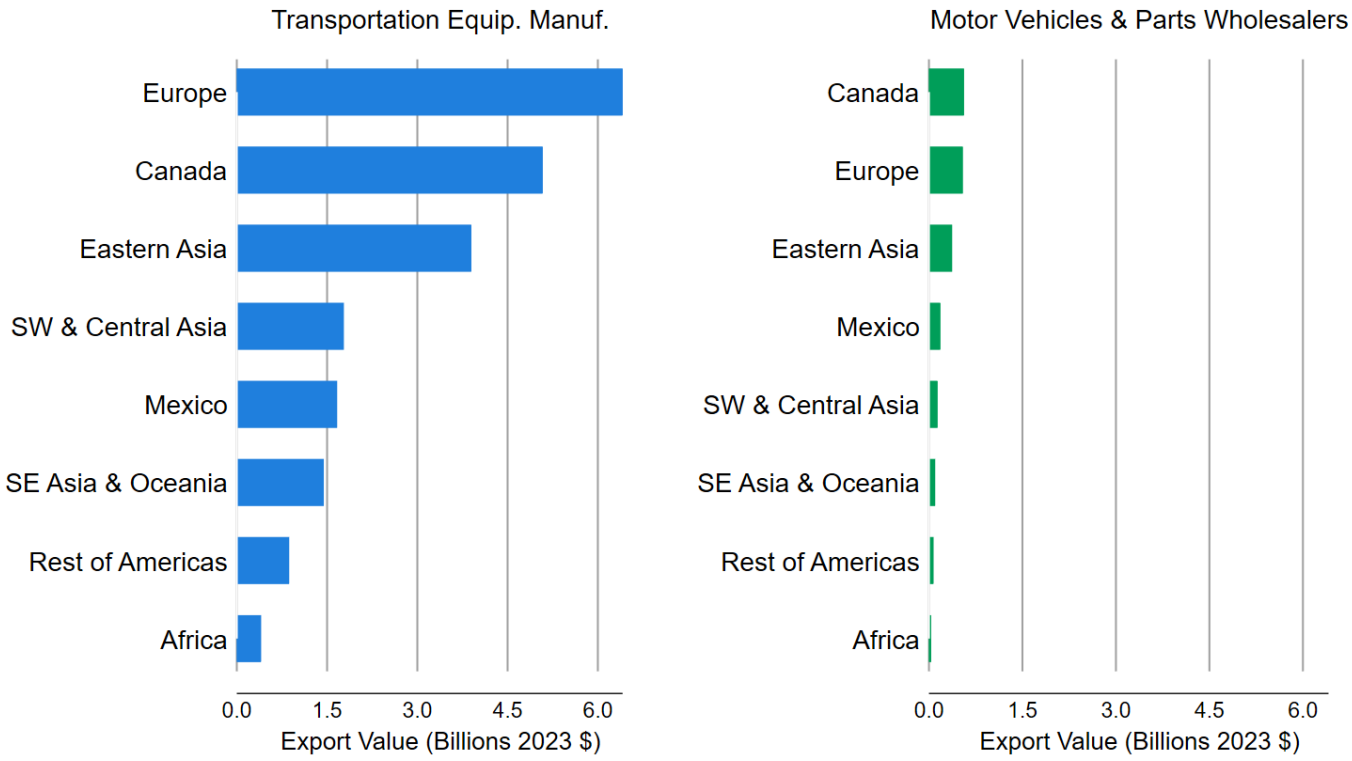
Figure 2.8.5 Top Ports of Exit for the Transportation Equipment and Vehicles Cluster by Industry, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

Europe and Canada are the most common destinations of transportation equipment and vehicles exports from Appalachia, accounting for 30 percent and 24 percent of the cluster's total exports, respectively. In the relatively larger transportation equipment industry, Europe imported $6.4 billion of Appalachia's exports in 2022, and Canada imported another $5.1 billion.

Figure 2.8.6 Transportation Equipment and Vehicles Cluster Export Destinations, 2022



Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.
Note: Foreign zones are defined by the United Nations Statistics Division: https://unstats.un.org/unsd/methodology/m49/.

2.8.4 Transportation Shipping by Mode

Freight exported from Appalachia must first be transported to a port of exit within the United States. During this first leg of the journey, about 61 percent of the transportation equipment and vehicles cluster's total export value is shipped by truck. Rail accounts for another 21 percent of transportation equipment and vehicles products in transit to the port of exit, such as the freight rail connection from Inland Port Greer (SC) to the port of Charleston.

From the port of exit to the final destination, over half of Appalachia's transportation equipment and vehicles exports were shipped via water, totaling $11.8 billion in 2022. Air was also a common mode for transportation equipment manufacturing (such as specialty parts), totaling $4.6 billion and trucks carried another $4.1 billion of the industry's exports from Appalachia.

Table 2.14 Transportation Equipment and Vehicles Cluster Export Mode from Appalachia, 2022

Transportation Equip. Manuf.			Motor Vehicles & Parts Wholesalers		
Mode	Export Value 2022 (Billions)	Share of Total Exports	Mode	Export Value 2022 (Billions)	Share of Total Exports
Water	$10.73	50%	Water	$1.08	54%
Air (including truck-air)	$4.58	21%	Truck	$0.43	21%
Truck	$4.13	19%	Rail	$0.27	13%
Rail	$1.98	9%	Air (including truck-air)	$0.22	11%
Multiple modes & mail	$0.10	<1%	Multiple modes & mail	$0.00	<1%

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

2.9. Summary of Findings

Several of the industries identified as regional strengths in the 2004 report[12] remain prominent in Appalachia today, including machinery, auto parts, and electronics. This updated analysis and methodology also highlights some different clusters of regional importance, such as chemicals and plastics, consumer products, and metals and minerals.

Each of the clusters identified in this updated analysis has substantial employment and is export-oriented, either in terms of export share or total value of exports. As seen in Table 2.15 below, the transportation equipment and vehicles and chemicals and plastics clusters export the largest value from Appalachia. Europe is a key trading partner for both clusters and shipments are most commonly made via water. In contrast, the electronics, machinery, and metals and minerals clusters are more likely to use air transport to export their products.

Wages in these export-oriented clusters tend to be substantially higher than the average wage for all jobs in Appalachia (about $59,000) as well as the average wage for manufacturing jobs in the region (about $67,000). Each of the export-oriented clusters pay wages in excess of $70,000, and as high as $96,000 in the mining industry. Of the export-oriented clusters, only the consumer products cluster pays wages in line with the Appalachian regional average.

[12] Jack Faucett Associates and Economic Development Research Group, 2004. Analysis of Global Competitiveness of Selected Industries and Clusters in the Appalachian Region. https://www.arc.gov/report/analysis-of-global-competitiveness-of-selected-industries-and-clusters-in-the-appalachian-region/.

Apart from mining, where employment fell by 29 percent, employment in all seven clusters grew over the last decade. The transportation equipment and vehicles cluster had the greatest growth, increasing by 29 percent since 2013, followed by the chemicals and plastics cluster which grew by 16 percent.

Table 2.15 Summary and Comparison of Clusters

Cluster	Employment 2023	Change in Employment 2013-2023	Average Wage 2023	Cluster Output 2022 (Billions)	Cluster Exports 2022 (Billions)	Top Export Destination 2022	Primary Export Mode 2022
Chemicals & Plastics	190,000	16%	$72,000	$227	$20	Europe	Water
Consumer Products	204,000	9%	$59,000	$220	$10	Canada	Water
Electronics	123,000	5%	$80,000	$110	$14	Canada	Air
Machinery	192,000	7%	$82,000	$117	$13	Canada	Air
Metals & Minerals	306,000	4%	$71,000	$161	$13	Europe	Air
Mining	48,000	-29%	$96,000	$88	$8	Europe	Water
Transportation equipment & vehicles	230,000	29%	$70,000	$184	$24	Europe	Water

Source: Cambridge Econometrics based on data from 1) The Bureau of Transportation Statistics' Freight Analysis Framework 5 https://www.bts.gov/faf, 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) The Bureau of Transportation Statistics' Commodity Flow Survey (CFS) https://www.bts.gov/cfs.

The three clusters with the **greatest employment** in Appalachia are:

- Metals and minerals (306,000 employees)
- Transportation equipment and vehicles (230,000 employees)
- Consumer products (204,000 employees)

The three **fastest-growing** clusters over the past 10 years are:

- Transportation equipment and vehicles (29%)
- Chemicals and plastics (16%)
- Consumer products (9%)

The three **highest-paying** clusters (in annual average wages) are:

- Mining ($96,000)
- Machinery ($82,000)
- Electronics ($80,000)

The three **largest exporting** clusters are:

- Transportation equipment and vehicles ($24 billion)
- Chemicals and plastics ($20 billion)
- Electronics ($14 billion)

These clusters represent important pillars of Appalachia's economy and competitiveness in international markets. Focusing on exports strengthens these industries' resilience against domestic policies and demand fluctuations, attracts foreign capital to Appalachia, and stimulates economic growth through increased international trade. Furthermore, jobs in these clusters are typically well-compensated, offering wages that are higher than the regional average. This not only improves the standard of living for workers but also stimulates local economies through increased consumer spending. High-paying jobs also attract skilled labor, which is essential for maintaining the quality and productivity of these industries. With supportive policies, high-quality multimodal transportation connections to ports and economic development planning, the success of these clusters can lead to broader community and regional development. As these industries grow, they create additional jobs in related sectors such as logistics, retail, and services. This growth can lead to improved infrastructure, better public services, and enhanced quality of life for residents.

3. Economic Contribution of Transportation

This section provides estimates of the importance of transportation to the Appalachian economy and its key industries. Complementing and expanding upon the discussion of transportation needs for export-oriented industries, this analysis quantifies the overall transportation needs, in dollar terms, for all industries, including sectors such as construction, domestic-facing wholesale and retail trade, and services and utilities.

The importance of transportation to the Appalachian economy can be illustrated using the total value of expenditures by industry on transportation services. In economic terms, this concept is also referred to as the "economic contribution" of transportation and can be defined as the proportion of the total value of goods and services produced by industries ("output") that is attributable to transportation services.

The following sections describe the data and methodology used to estimate expenditures on transportation in Appalachia and the key findings of this analysis, including the overall importance of transportation to the region, the importance of different modes of transportation, and the industries that spend most on transportation services.

3.1. Methodology

The US Bureau of Economic Analysis (BEA) publishes data that includes estimates of the economic contribution of *for-hire* transportation services (services provided by transportation firms to industries and the public on a fee-basis, such as air carriers, railroads, transit agencies, common carrier trucking companies, and pipelines). The BEA data provides estimates, by industry, of the percentage of total industry output that is attributable to for-hire transportation services. However, these data do not include estimates of the contribution of *in-house* transportation services (transportation activity carried out by non-transportation industries for their own purposes). To fill this gap, the US Bureau of Transportation Statistics (BTS) produces the Transportation Satellite Accounts (TSAs), which expand upon the data published by the BEA to include estimates of the value of *both* for-hire and in-house transportation services.[13] The TSAs therefore provide a more accurate estimate of the overall role of transportation in economic activity.[14]

[13] The TSAs also include estimates of the contribution of transportation activity carried out by households through the use of private motor vehicles (known as household production of transportation services). This category is not included in this analysis.
[14] Bureau of Transportation Statistics. Transportation Satellite Accounts. July 2, 2024. https://www.bts.gov/satellite-accounts.

While the TSAs provide a comprehensive estimate of the contribution of transportation, they are limited in geographic specificity: the TSAs are provided only at a national level, and therefore do not account for regional differences in industries' transportation needs. This analysis therefore assumes that, as a share of output, Appalachian industries follow national trends in transportation needs. More research on the industry-specific supply chain, modal mix, and the average distance to market in Appalachia relative to the United States would be needed to understand if this assumption holds true. For example, being a more rural area, the region may have less access to major airports with air freight capacity and connections than the rest of the country and thus may be less reliant on that mode.

To estimate total expenditures on transportation in Appalachia, TSA transportation contributions for each industry are multiplied by estimated industry output in Appalachia. Industry output data are published only at the state level; therefore, to estimate Appalachia-specific output, the state-level output data is apportioned to Appalachia using the regional share of overall state employment for each industry (for more information on this method as it was used in the analysis of export-oriented industry clusters, see the Appendix). The dollar value of industry expenditures on transportation services thus reflects the size and mix of industries present in Appalachia.

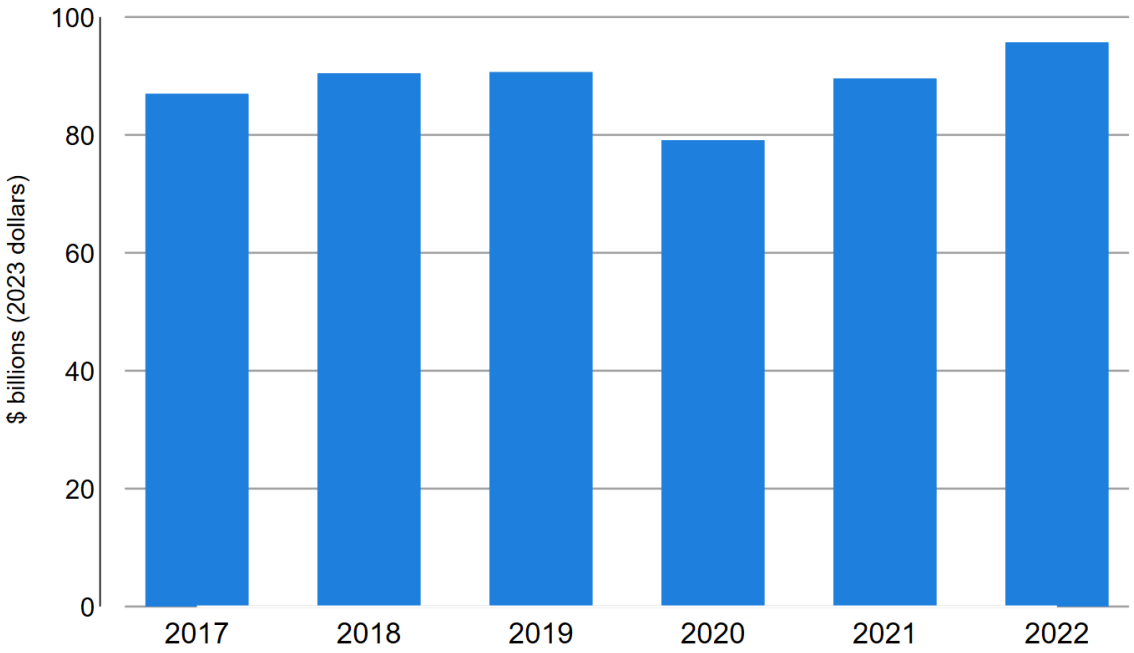
While this analysis demonstrates the overall importance of transportation to the Appalachian economy, it is important to note two important limitations. First, as described above, estimates of the economic contribution of transportation are available at a national level only; this analysis therefore assumes that Appalachian industries follow national trends in transportation needs. Second, this high-level analysis of the *total* spending on transportation does not provide an indication of the necessity of a particular mode of transportation to the viability of a particular industry or company. For example, an industry in Appalachia may be highly reliant upon rail services for its operations (and to lower the costs of doing business compared to other modes), even though its total expenditures on rail are relatively minor in comparison to its overall output.

3.2. Findings

Appalachian industries spent approximately $96 billion on transportation services in 2022 – accounting for 3.4 percent of total output in the region. There is some variation between subregions due to the different mix of industries present in each subregion: in the North, transportation accounts for 3.1 percent of regional output on average, while in the North Central, it accounts for 3.7 percent.

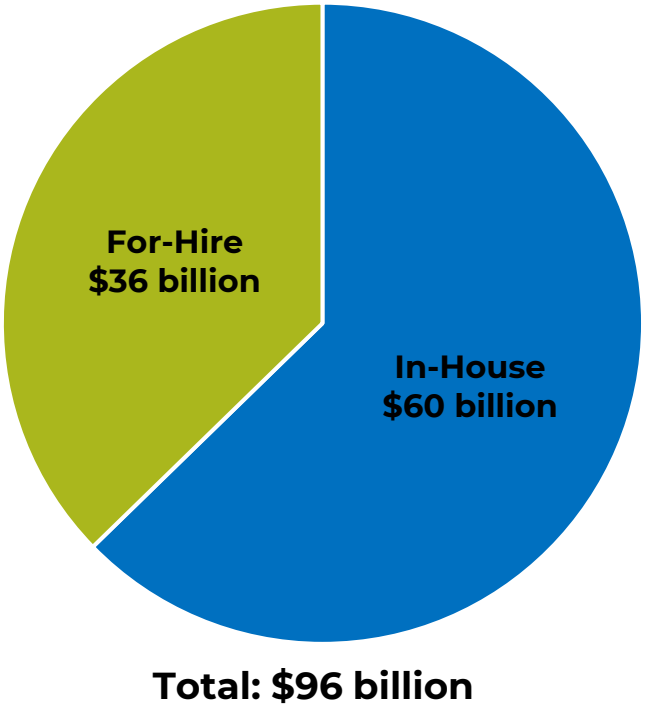
Since 2017, total transportation expenditures have increased from around $87 billion in 2017 to $96 billion in 2022, as shown in Figure 3.2.1. This trend is driven primarily by an increase in regional output, rather than industries in the region becoming more reliant on transportation. In-house transportation expenditures in 2022 were approximately $60 billion, representing 63 percent of total transportation expenditures, as shown in Figure 3.2.2. The share of for-hire and in-house transportation services have remained relatively constant since 2017.

Figure 3.2.1 Total Appalachian Industry Expenditures on Transportation, 2017-2022



Source: Cambridge Econometrics with data from 1) US Bureau of Transportation Statistics' (BTS) Transportation Satellite Accounts (TSAs), 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) US Bureau of Economic Analysis' (BEA) Annual GDP by State and Industry (SAGDP)

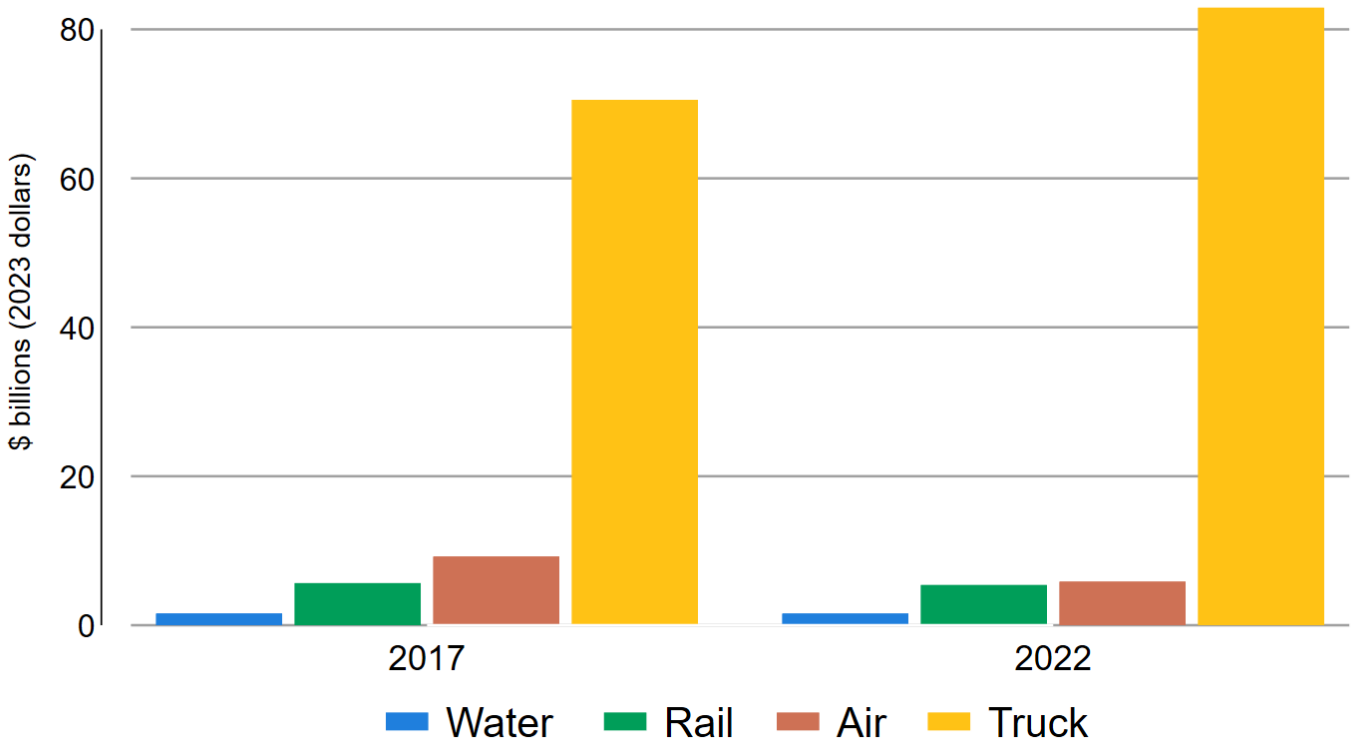
Figure 3.2.2 For-Hire and In-House Appalachian Industry Expenditures on Transportation, 2022



Source: Cambridge Econometrics with data from 1) US Bureau of Transportation Statistics' (BTS) Transportation Satellite Accounts (TSAs), 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) US Bureau of Economic Analysis' (BEA) Annual GDP by State and Industry (SAGDP)

Trucks are the most widely used mode of transportation, as shown in Figure 3.2.3. Across Appalachia, industries spent $83 billion on truck transportation services in 2022 – 87 percent of total expenditures on transportation services. Industries spent $5.8 billion on air transportation, $5.4 billion on rail transportation, and $1.6 billion on water transportation in 2022. The value of truck transportation has increased by 17 percent from 2017, when Appalachian industry spending on truck transportation was $71 billion. While expenditures on truck transportation have increased since 2017, expenditures on rail decreased by 4% and air fell by 37% over this period. The decline in air transportation contribution is largely attributed to the impacts of the Covid-19 pandemic: air transportation expenditures fell from $9.4 billion in 2019 to $4.2 billion in 2020 and by 2022 had only recovered slightly, reaching $5.8 billion.

Figure 3.2.3 Appalachian Industry Expenditures on Transportation by Mode, 2017 and 2022

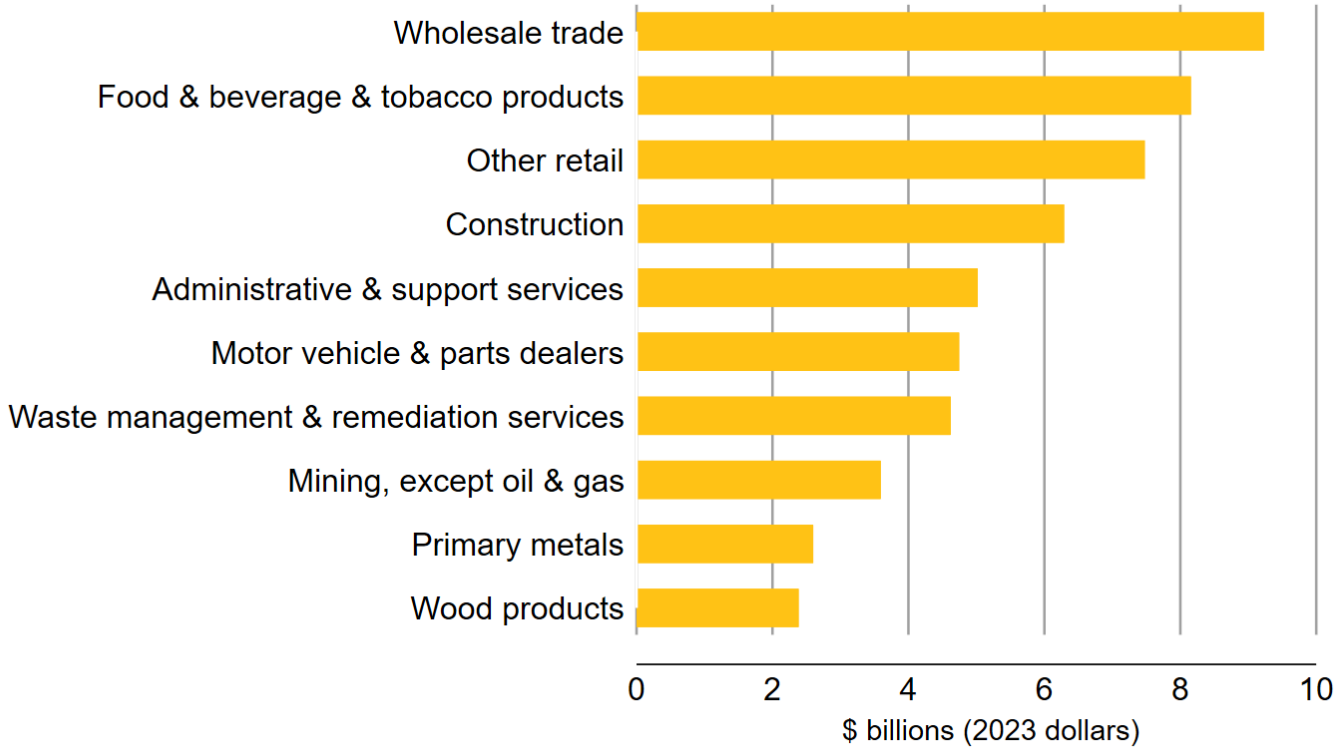


Source: Cambridge Econometrics with data from 1) US Bureau of Transportation Statistics' (BTS) Transportation Satellite Accounts (TSAs), 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) US Bureau of Economic Analysis' (BEA) Annual GDP by State and Industry (SAGDP)

The ten industries with the greatest total expenditures on truck transportation in Appalachia in 2022 are presented in Figure 3.2.4. These industries include wholesale and retail trade sectors (wholesale trade; other retail; motor vehicle and parts dealers), construction, waste management, and manufacturing and production sectors (food, beverage, and tobacco products; mining; primary metal manufacturing; and wood products manufacturing. Additionally, many of these industries are among the key export-oriented industry clusters identified in the previous section.

Spending on truck transportation by these industries ranged from $9.2 billion by the wholesale trade sector to $2.4 billion by the wood products sector. In total, these ten industries spent $54 billion on truck transportation services – 65 percent of the region's total expenditures on truck transportation. For some of these industries, truck transportation constitutes a large share of the total value of industry output – for example, 38 percent of the total value of the waste management sector is attributable to truck transportation, as well as 10 percent of the value of the mining sector.

Figure 3.2.4 Industries with Greatest Spending on Truck Transportation in Appalachia, 2022

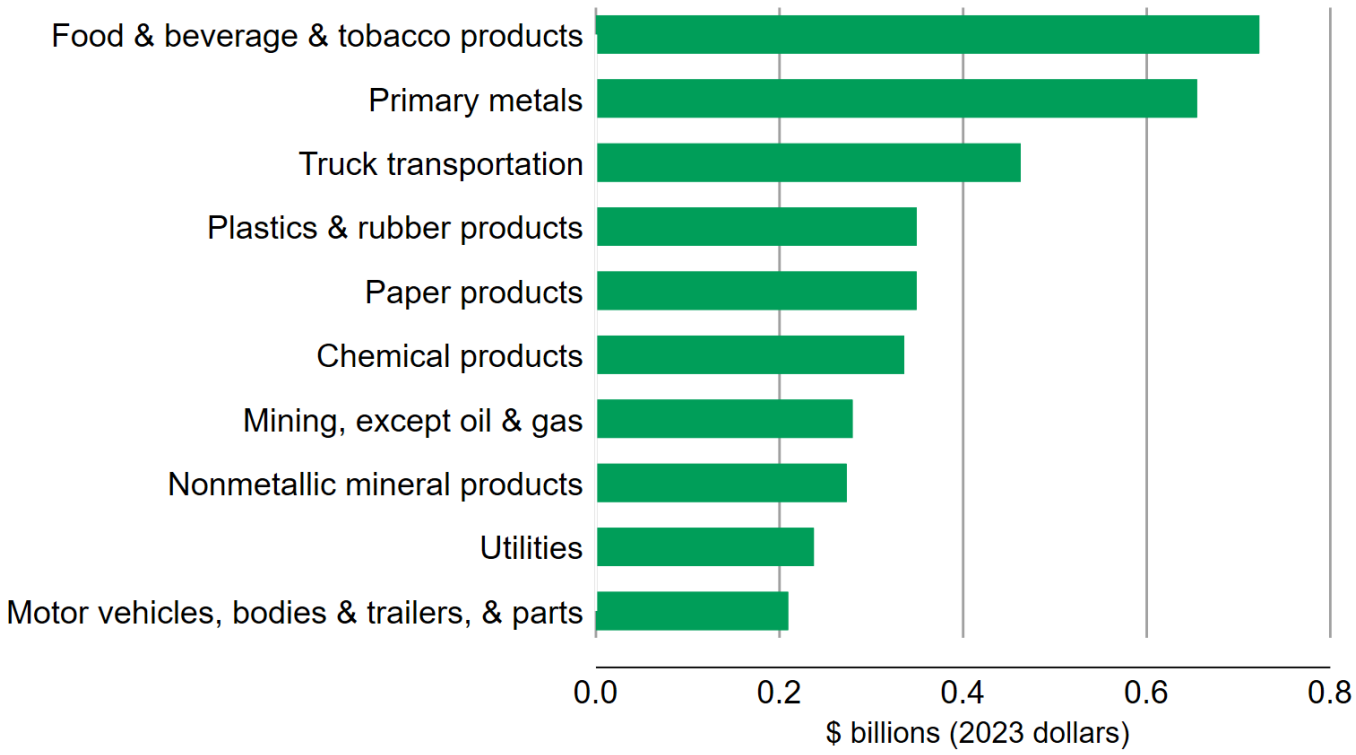


Source: Cambridge Econometrics with data from 1) US Bureau of Transportation Statistics' (BTS) Transportation Satellite Accounts (TSAs), 2) Mass Economics' dataFab https://masseconomics.com/data-fab/, and 3) US Bureau of Economic Analysis' (BEA) Annual GDP by State and Industry (SAGDP)

Figure 3.2.5 presents the ten industries with the greatest total expenditures on rail transportation in Appalachia in 2022. Many of the industries with the greatest expenditures on rail transportation are also among those with the greatest spending on truck transportation, such as food, beverage, and tobacco products; primary metals manufacturing; motor vehicles, and mining. This overlap is due both to the fact that these industries are among those with the greatest total output in Appalachia (and therefore contribute the most towards spending on *all* forms of transportation) and because industries may use rail and truck transportation in a complementary fashion (e.g., if rail facilities have intermodal connections with truck transportation services).

Spending on rail transportation in 2022 by these industries ranged from $700 million by the food, beverage, and tobacco products sector to $200 million by the motor vehicles, bodies, trailers, and parts sector. In total, these ten industries spent $3.9 billion on rail transportation services – 72 percent of total regional spending on rail transport. As a proportion of total output in these industries, spending on rail transportation is much lower than spending on truck transportation: rail transportation constitutes one percent or less of total output for each of these industries.

Figure 3.2.5 Industries with Greatest Spending on Rail Transportation in Appalachia, 2022



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In summary, Appalachian transportation expenditures contribute almost $100 billion to the United States economy each year. Nearly two-thirds (63 percent) of all transportation expenditures are in-house, highlighting the importance of trucking fleets in particular. Expenditures on truck transportation account for 87 percent of all transportation expenditures ($83 billion in 2022), and the share of trucking activity is increasing compared to other modes of transportation. This growth is due in large part to the expansion of the wholesale and retail trade sectors (as discussed in the following section) and highlights the need for continued investment in infrastructure to support road transportation.

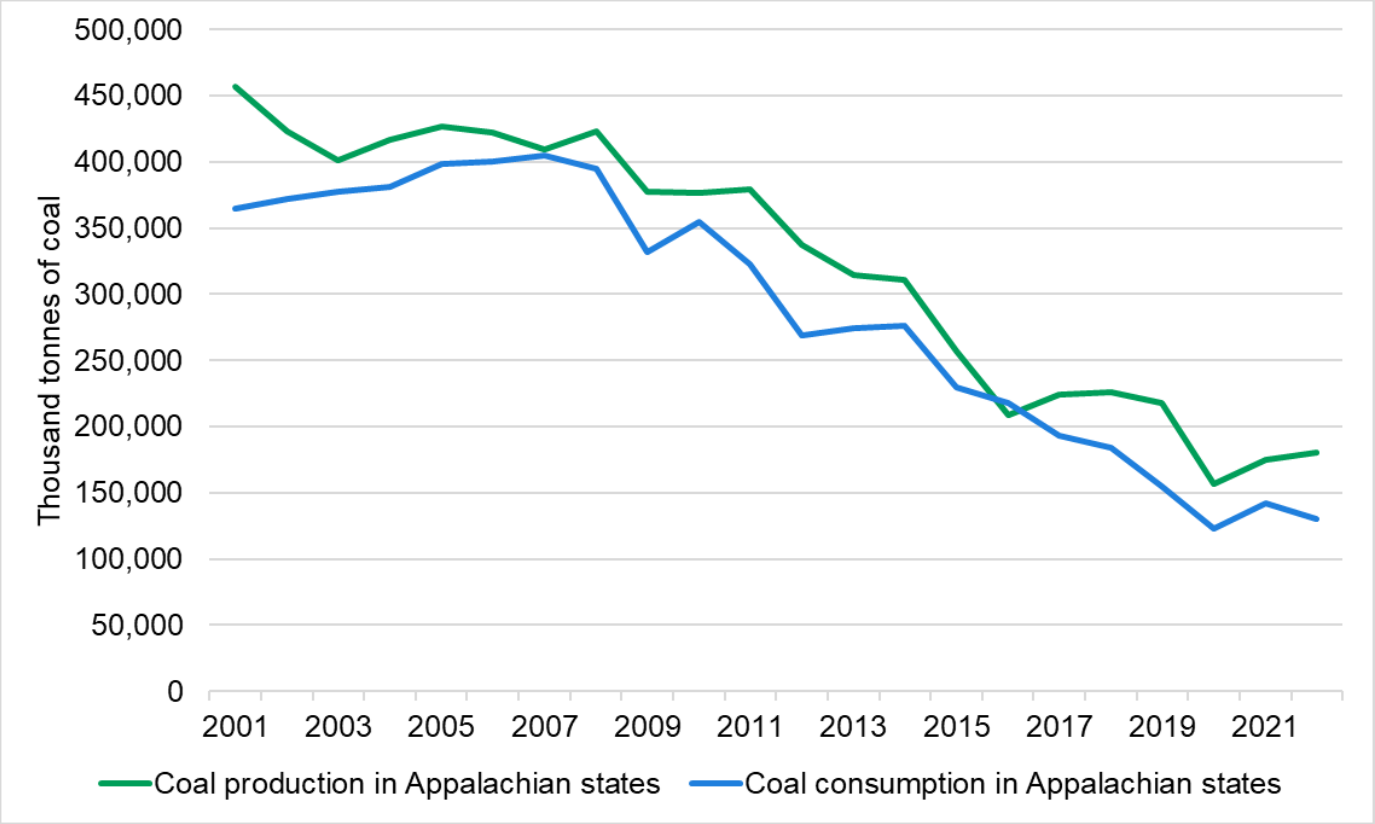
4. Key Freight Industry Trends in Appalachia

Closely related to trade and key industry clusters, Appalachia has experienced two broad industry trends influencing freight transportation. First, the region (and the nation as a whole) has seen a steady decline in the production, use, and therefore transportation, of coal, which in turn influences the demand for rail transportation services. These trends are discussed in section 4.1. Second, the region has experienced substantial growth in warehousing and distribution activities due to increasing consumer demand, evolving import shipping patterns, and last-mile same-day deliveries. These trends are discussed in section 4.2.

4.1. Decline of Coal

The production and consumption of coal in Appalachian states has been steadily declining since peaking in 2005. As shown in Figure 4.1.1, coal production in Appalachia decreased by about 58 percent from 2005 to 2022, and coal consumption by 67 percent over the same period. The declines in Appalachia were much steeper than the average for non-Appalachian states (which are less coal-dependent), which saw production decline by 41 percent and consumption decline by 47 percent.

Figure 4.1.1 Coal Production and Consumption in Appalachia, 2001-2022



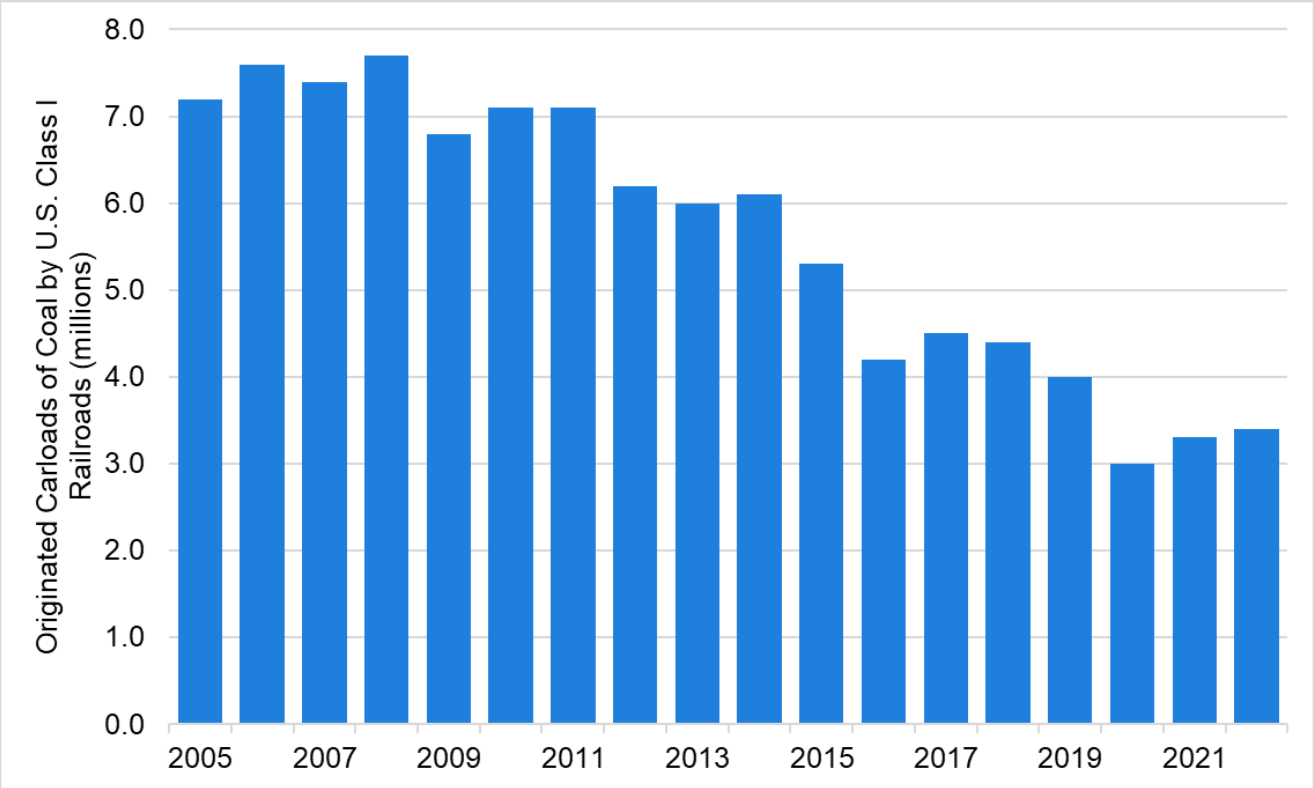
Source: Cambridge Econometrics, based on U.S. Energy Information Administration, Total consumption for coal, and Aggregate coal mine production https://www.eia.gov/electricity/data/browser

ARC-commissioned research identified two major national factors contributing to the decline in coal demand across the U.S. and Appalachia:[15] a *"major contributing factor"* has been the *"decline of natural gas prices in the electric power sector, which constitutes the largest source of domestic demand for coal"*. This trend has been the result of the *"widespread use of horizontal drilling and hydraulic fracturing techniques in shale formations…that led to a dramatic increase in natural gas production - to the point that the U.S. is now a net exporter of natural gas."* Additionally, the research also found "*while natural gas prices provide the most important factor in declining coal demand in the electric power sector, the federal environmental regulatory climate has also increased the cost of burning coal through a series of regulations"*.

[15] Bureau of Business and Economic Research, West Virginia University, 2023. Coal Production and Employment in Appalachia https://www.arc.gov/report/coal-production-and-employment-in-appalachia-2023/.

One of the direct implications of this decrease in coal demand has been an accompanying reduction in coal freight carried by rail, which is the predominant mode of transport for coal; across the U.S. in 2023, 55 percent of all domestic coal freight was carried via rail. Reflecting the decline in coal demand, carloads of coal shipped by rail in the U.S. have decreased by 56 percent from 2008 to 2022, as shown in Figure 4.1.2.

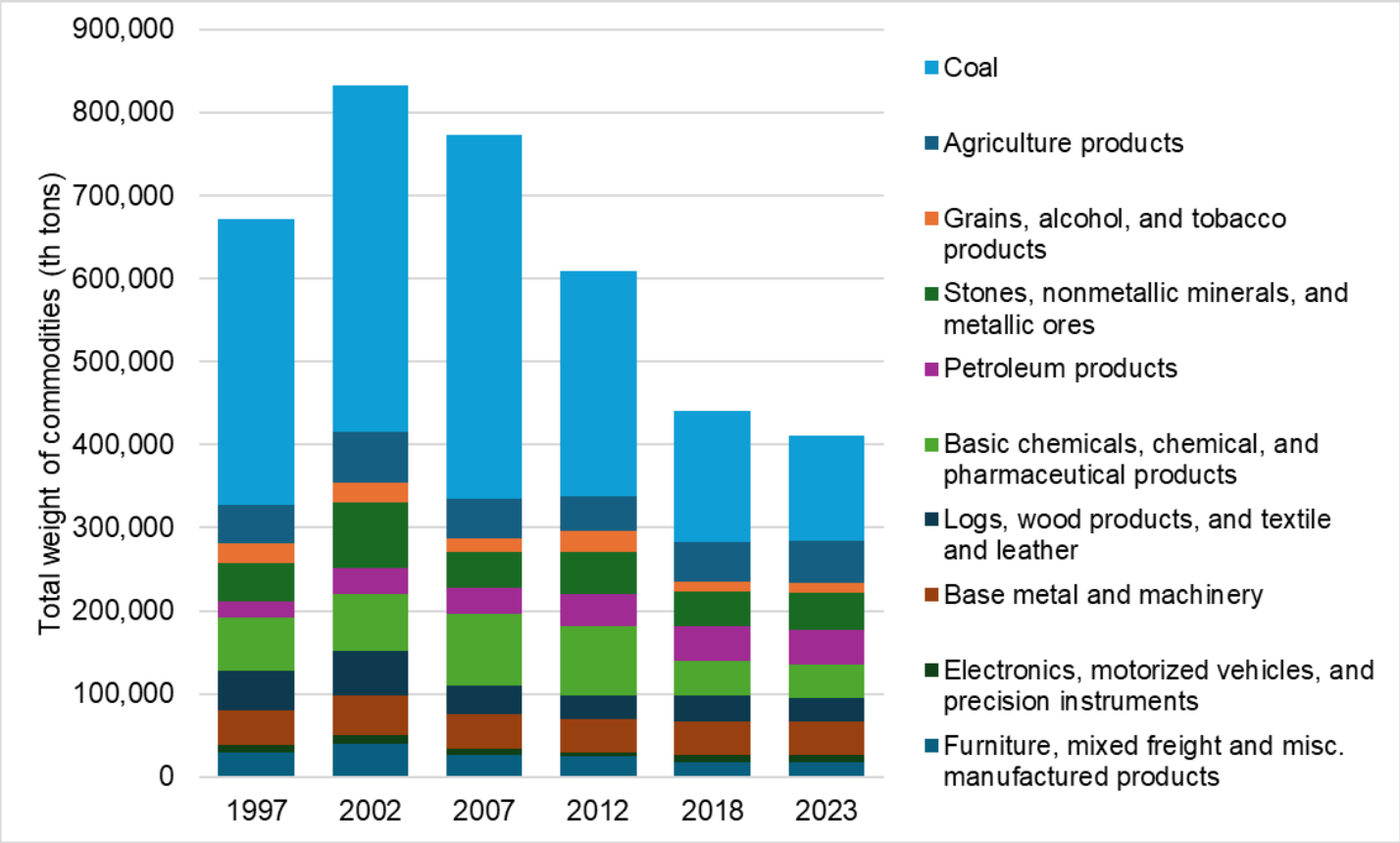
Figure 4.1.2 U.S. Coal Rail Carloads, 2005-2022



Source: Cambridge Econometrics, based on American Association of Railroads, Freight Rail Traffic Data https://www.aar.org/data-center/rail-traffic-data

Within Appalachia, coal shipments via rail have followed a similar trend to the national trends depicted in Figure 4.1.2. At its peak in 2007, 437,000 tons of coal were shipped by rail in Appalachia, making up 57 percent of total rail tonnage that year. By 2022, coal shipments had declined by 71 percent to 127,000 tons, as shown in Figure 4.1.3. The modest increase in coal shipments from 2020 to 2022 reflects a combination of a rebound from the severe downturn in all economic activity in 2020 due to Covid-19, and the global increase in natural gas prices (largely related to the war in Ukraine), which made coal a more economically viable option for power generation. Despite these broader trends, coal remains the largest commodity for rail transportation, making up 31 percent of total tonnage in 2023.

Figure 4.1.3 Commodities Transported by Rail in Appalachia, 1997-2023



Source: Cambridge Econometrics using Bureau of Transportation Statistics, Freight Analysis Framework 5 https://www.bts.gov/faf
Note: includes all commodities originating and terminating in ARC states, including those with origins/destination outside ARC states

However, over the same period, the trend for most other commodities in Appalachia has been much more stable, and for some, their total rail tonnage has increased. For instance, tonnage shipped by rail increased between 2007 and 2023 for electronics, motorized vehicles, and precision instruments (47 percent), petroleum products (32 percent), stones, nonmetallic minerals, and metallic ores (4 percent), and agriculture products (3 percent). These commodities now collectively account for a higher share of total rail tonnage in Appalachia (36 percent) than coal.

As demand for coal decreases, there may be corresponding declines in shipments of complementary products. For example, shipments of limestone – used as an environmental control in power plants – may decrease alongside coal shipments. Additionally, infrastructure can present challenges for entering new markets. For example, while it may be technically and economically feasible to ship a commodity to a destination market by rail, if a suitable transloading facility is not in place, the opportunity is not viable. However, certain opportunities still remain for coal – in particular, for anthracite coal, which is more specialized and commonly exported (where

demand for coal has remained more consistent). And based on experiences shared by short line railroads in Appalachia, there remain opportunities to support industrial development with freight rail service – but it requires a mix of partnerships (between railroads and economic development leaders), rail infrastructure (tracks, spurs, yards), and creative problem-solving to help commodity-based companies how they can use (or expand their use of) freight rail to lower operating costs and improve competitiveness.

In terms of value, these growing non-coal commodities collectively represent approximately half (51 percent) of the total commodity value carried by rail in Appalachia – while coal represents only 7 percent of value shipped – reflecting the significantly higher per ton value of these other commodities. Additionally, these commodities are linked to some of Appalachia's established, fast-growing industry clusters – notably electronics, machinery, and transportation, metals & minerals, and consumer products (especially related to food manufacturing), which have taken advantage of the reliable and cost-efficient access to both domestic and global markets provided by Appalachia's rail network.

The opportunities associated with transporting these commodities by rail has also been boosted by the growth in inland ports that are used as rail connections, such as Greer, SC and the Appalachian Regional Port, Crandall, GA. Such ports offer excellent accessibility and cost-effectiveness incentives for freight rail, boosted by their intermodal service offer and proximity to US interstates, Appalachian Development Highway System (ADHS), and other major highways.

ARC-commissioned research has found that the increased movement of non-coal commodities via such inland ports can provide important benefits to the regions they serve:

> *"First … these facilities are a revenue-rich source of alternative freight activity that can preserve and improve traffic densities within railroad corridors where coal volumes are declining.*
>
> *Second, and perhaps more importantly, the development of inland port facilities can level the transportation playing field for Appalachian producers and product distributors who would otherwise be disadvantaged by higher transportation costs and less reliable freight services."*[16]

Over the past twenty years, coal demand in Appalachia has fallen significantly and is projected to continue declining. Given the dependency of Appalachia's freight rail network on the movement of coal, there are clear benefits to enabling and supporting greater movement of non-coal commodities, particularly via inland ports, which serve as an accessible and cost-effective freight alternative for Appalachian produces and distributors.

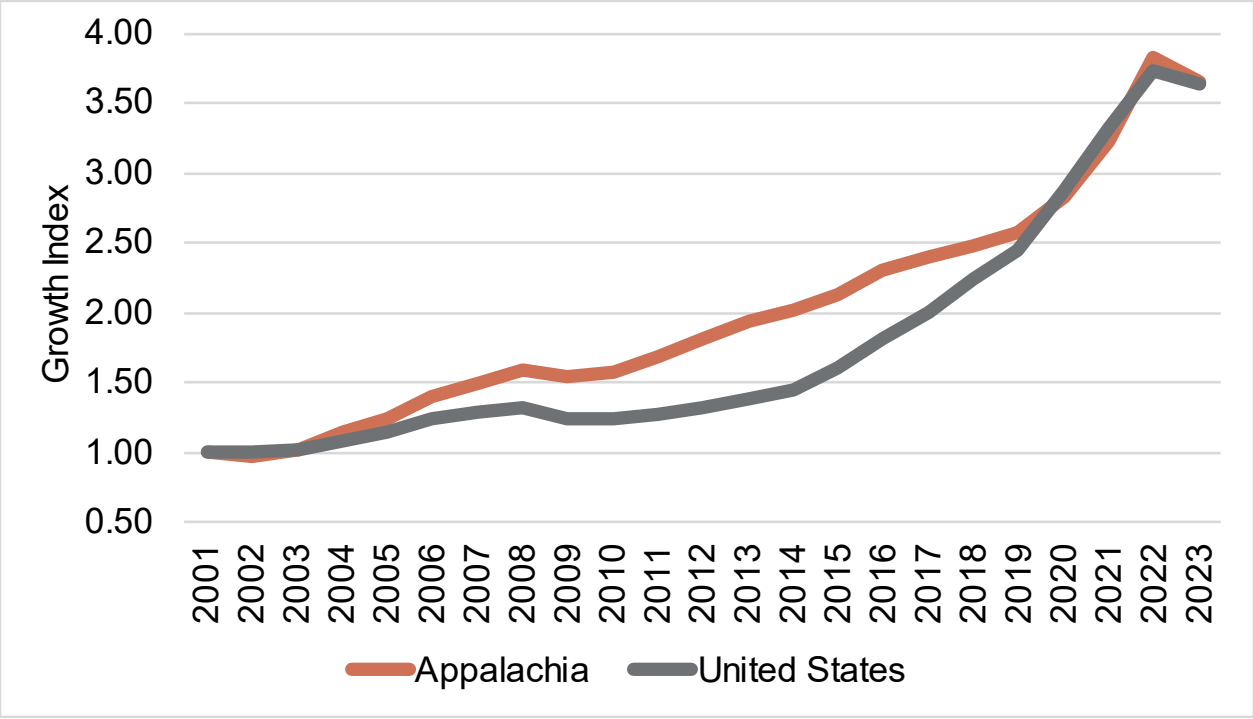
[16] Center for Transportation Research, The University of Tennessee, 2017. Preserving Appalachia's Rail Connectivity in the 21st Century: Part Two https://www.arc.gov/report/access-vs-isolation-preserving-appalachias-rail-connectivity-in-the-21st-century/.

Such benefits are already being realized, as shown in the recent growth of non-coal commodities moved via rail, especially those relating to Appalachia's cluster strengths in electronics, machinery, and transportation, metals & minerals, and consumer products.

4.2. Increase in Warehousing and Distribution

Driven by strong consumer demand, evolving import shipping patterns, and last-mile same-day deliveries, warehousing and distribution center activity has grown substantially in Appalachia and the rest of the United States. Since 2001, warehousing and storage employment (NAICS 4931) in both Appalachia and the United States overall more than tripled, growing by about 265 percent. In 2001, about 37,000 people were employed in warehousing and storage in Appalachia. By 2023, that number had increased to about 136,000. Between 2004 and 2019, Appalachia's employment in the industry grew at a faster pace than the rest of the country, with growth post-pandemic, during more recent years in line with the national average.

Figure 4.2.1 Warehousing and Storage Employment Growth Index in Appalachia and the United States, 2001-2023

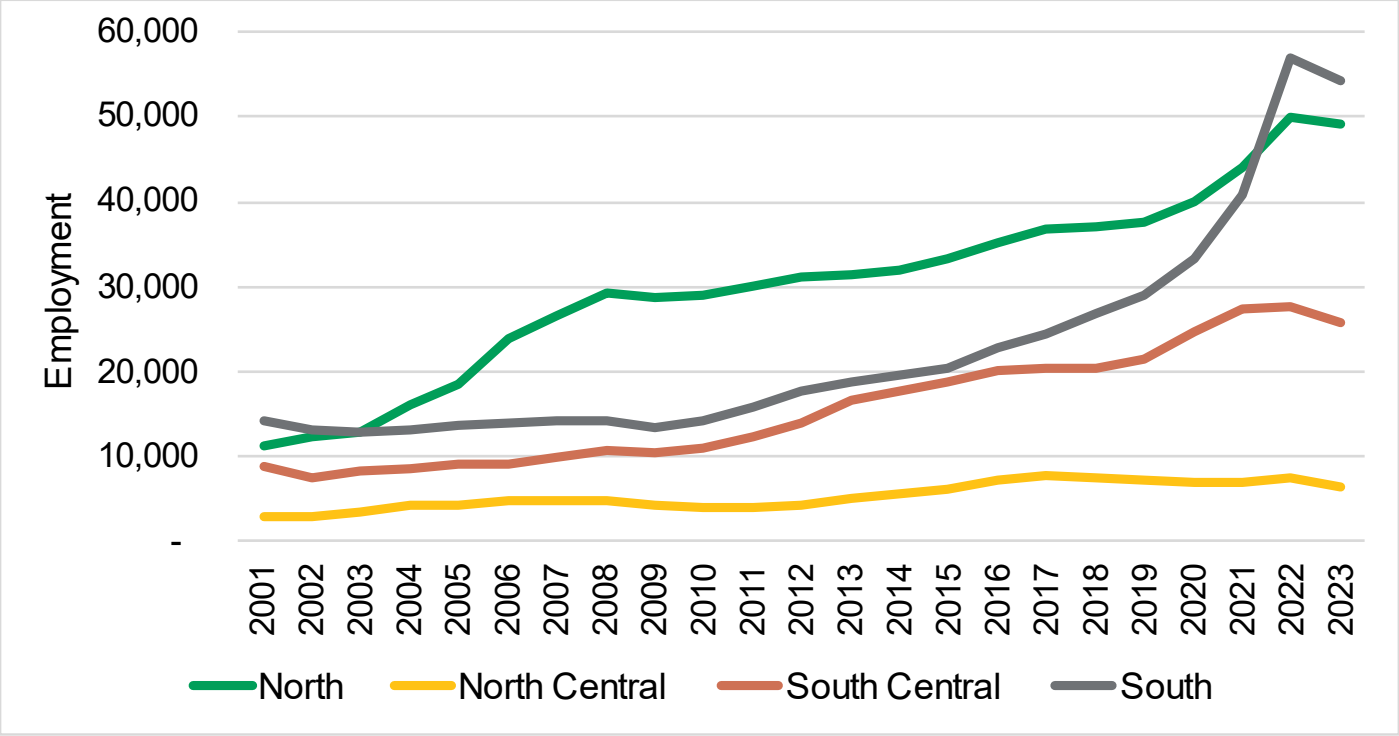


Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/

Growth in warehousing employment has not been spread evenly across Appalachia. The North and South

subregions grew by 38,000 and 40,000 employees, respectively, between 2001 and 2023 while the North Central and South Central subregions grew more slowly by 4,000 and 17,000. In some cases, warehouse facilities that are associated with other industries or uses may not be included in these estimates. For example, a large retail company with an attached warehouse or distribution center may be recorded under a retail NAICS code rather than warehousing and distribution. As a result, these values may be lower than the actual number of warehousing employees.

Figure 4.2.2 Employment in Warehousing and Storage by Subregion, 2001-2023



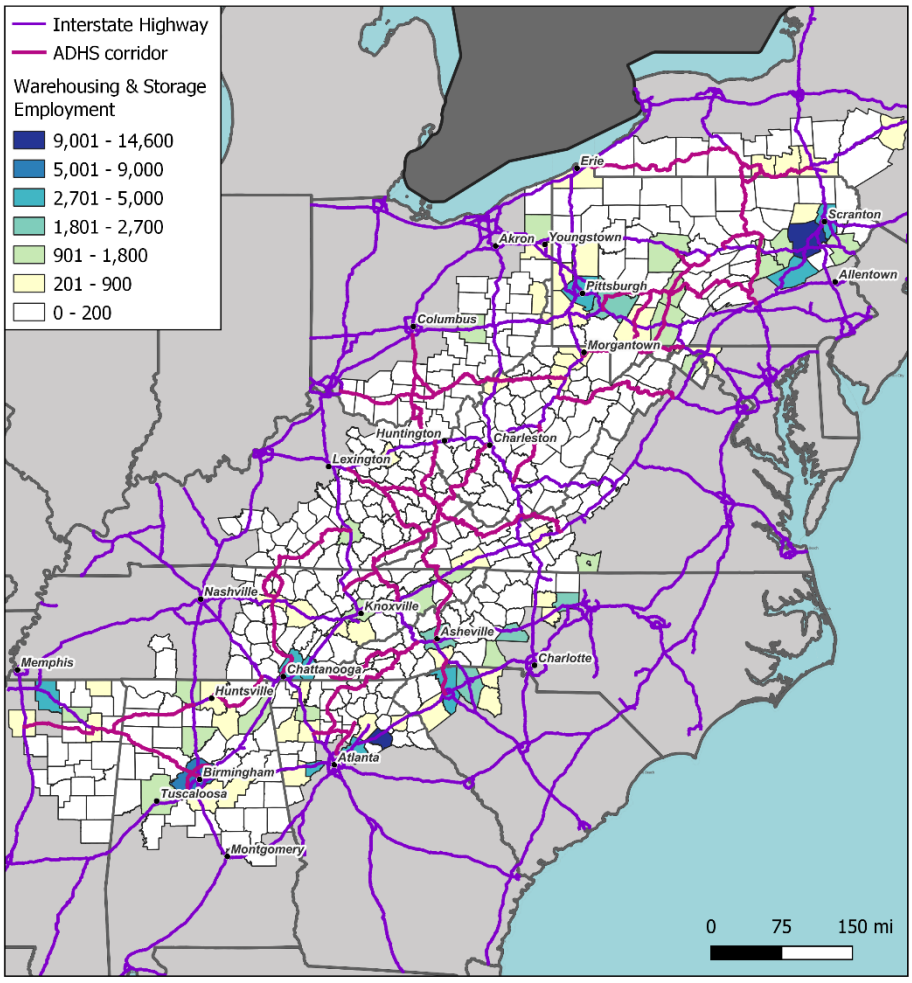
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/

Within these subregions, several counties around metro areas account for much of the warehousing and storage employment:

- Luzerne County, PA (in the Scranton area) with 14,600 warehousing and storage employees
- Jackson County, GA (in the Greater Atlanta area) with 13,200 warehousing and storage employees
- Jefferson County, AL (which includes the city of Birmingham) with 7,800 warehousing and storage employees

Locating outside of metro areas is advantageous for warehousing and distribution centers because it places them close to major population centers, while offering more large land sites for development and providing critical access to the Interstate Highway and Appalachian Development Highway System corridors that serve these cities. At the same time, traffic congestion, high costs, and land use restrictions can be challenging too close to major city centers, so somewhere just outside urban centers tends to be the best fit for this type of activity. Areas without access to the Interstate and/or ADHS network have minimal warehousing and storage employment.

Figure 4.2.3 Warehousing and Storage Employment by County, 2023



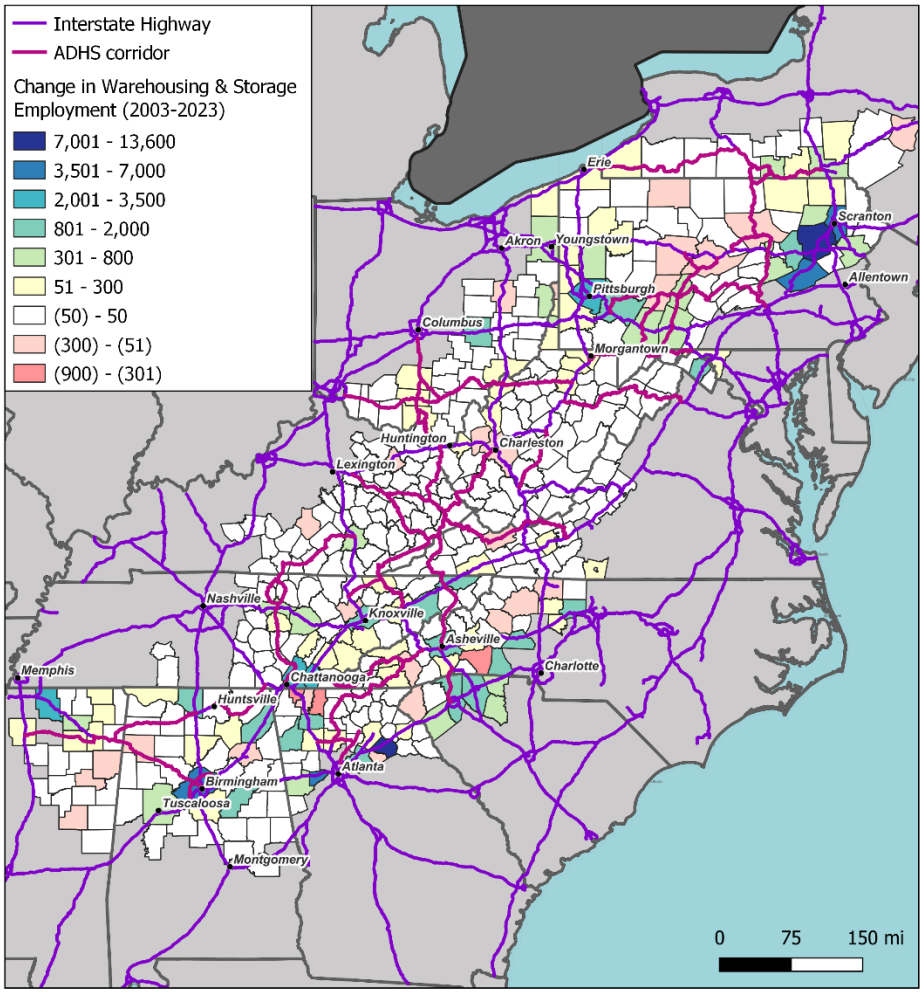
Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/

Those same three counties with the largest warehousing and storage employment base also experienced the largest growth in employment over the last 20 years. In 2003, Luzerne County, PA and Jefferson County, AL

had under 1,000 employees in the industry while Jackson County, GA had under 100. Luzerne County experienced steady employment growth in the industry over that period while Jackson County, GA and Jefferson County, AL saw large increases in employment in recent years. Jackson County, GA gained 8,800 new warehousing and storage employees between 2021 and 2022, in large part due to the opening of an 850,000 square foot Amazon Fulfillment Center. Jefferson County, AL, which experienced a sharp increase in warehousing and storage employment of 4,800 between 2020 and 2021, also had an Amazon distribution center open its doors in the county, along with Lowe's, FedEx, and several other large companies.[17] Other counties with a large increase in employment between 2003 and 2023 include Douglas County, GA (4,500 additional jobs), Schuylkill County, PA (4,300 additional jobs), Lackawanna County, PA (3,500 additional jobs), and Marshall County, MS (3,100 additional jobs).

[17] Bham Now, 2021. Birmingham emerging as a logistics & distribution hub in 2021. See how. https://bhamnow.com/2021/01/05/birmingham-emerging-as-a-logistics-distribution-hub-in-2021-see-how/.

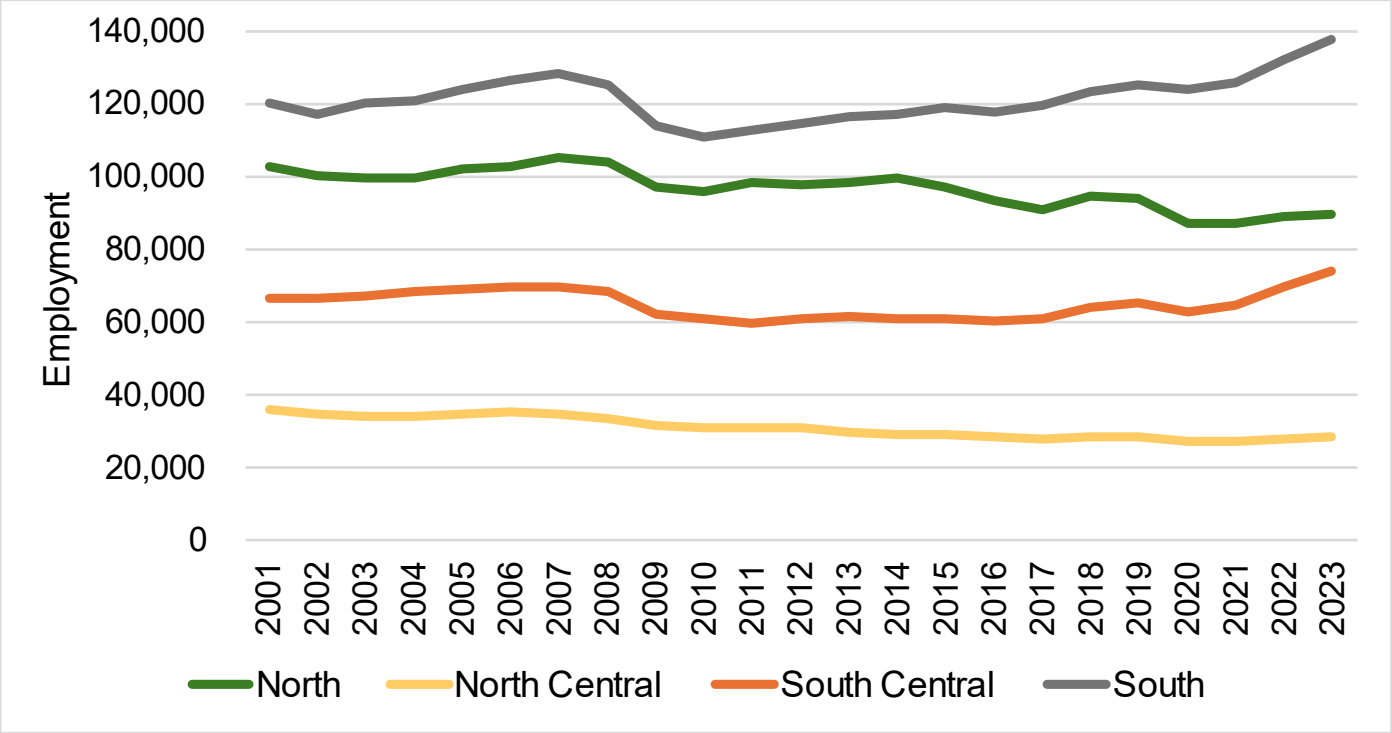
Figure 4.2.4 Change in Warehousing and Storage Employment, 2003-2023



Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/

Another related sector is wholesale trade (NAICS 423), which involves storing goods and arranging sales. Wholesalers often maintain warehouse facilities for inventory. As shown in Figure 4.2.5, employment in wholesale trade has not seen the same dramatic increase as warehousing and storage. However, the sector has been on an upward trend in the last few years following the Covid-19 pandemic in 2020, particularly in the South and South Central subregions. And the wholesale trade industry, which is one of the largest users of transportation in Appalachia, generates about 330,000 jobs, which is almost 2.5 times larger than warehousing.

Figure 4.2.5 Employment in Wholesale Trade by Subregion, 2001-2023

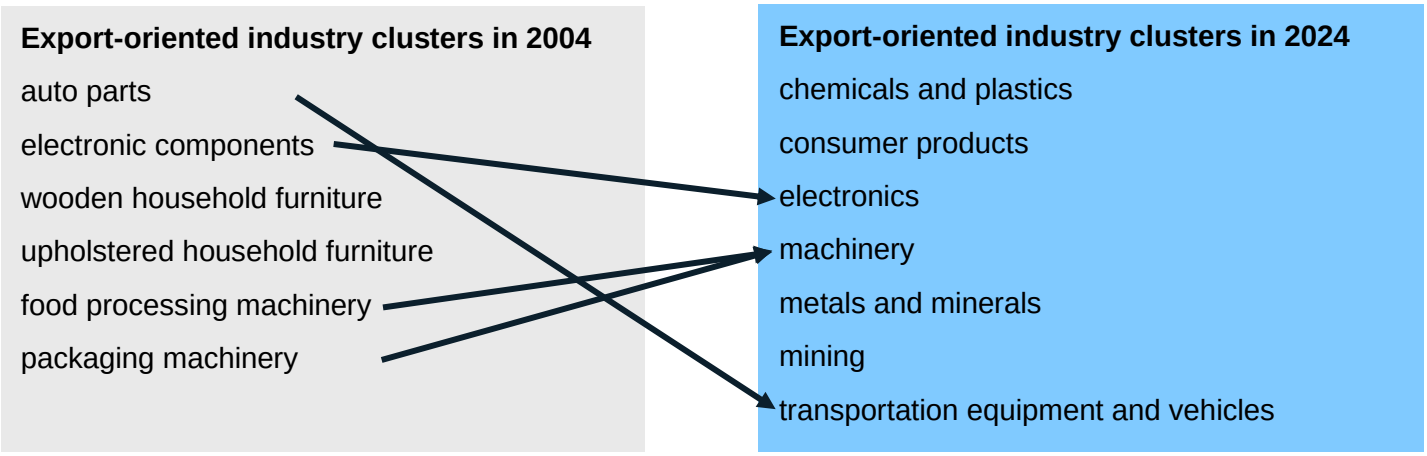


Source: Cambridge Econometrics with county level employment data from Mass Economics' dataFab https://masseconomics.com/data-fab/
Note: The figure shows employment for NAICS 423: Merchant Wholesalers, Durable Goods and 424: Merchant Wholesalers, Nondurable Goods.

Warehousing and storage services are crucial in linking manufacturers with both foreign and domestic consumers, making them essential for the distribution of most goods. The growth in this industry over the past few decades reflects its importance, driven by evolving consumer demands, the rise in e-commerce, and the increasing expectation of same-day or next-day deliveries. In Appalachia, the North and South subregions have seen the largest employment increases, particularly around urban centers. To provide fast delivery services in more rural areas, additional investments in last-mile connections, infrastructure improvements, and more warehouse facilities may be necessary. In these rural areas of Appalachia, enhancing accessibility and coordination between manufacturers, warehouses, and transportation services could also unlock export opportunities for companies that currently focus solely on the domestic market.

5. Summary of Findings

This study identified seven key export-oriented industries in Appalachia, based on both the industry cluster's share of exports and the overall size of the industry cluster. Key export-oriented industries in Appalachia have changed somewhat over the past 20 years. Transportation equipment manufacturing, electronics, and machinery have remained key export-oriented industries, while the furniture industry – while remaining an industry of regional specialization and importance – does not meet the threshold for identification as an *export-oriented* industry in this analysis. In its place, however, are the chemicals and plastics, consumer products, metals and minerals, and mining clusters.



The export-oriented clusters identified through this research represent important pillars of Appalachia's economy and competitiveness in international markets. Their export activities provide resilience against fluctuations in domestic demand and stimulate economic growth through increased international trade. These clusters make up about 15 percent of the region's overall employment and generate 85 percent of its foreign exports (about $102 billion in exports). Additionally, with the exception of mining, all of these clusters have seen growth in employment over the past 10 years, and mostly pay wages above the regional average.

Table 5.1 below presents a summary of the export industries across different metrics such as employment, growth, and value of exports with color coding by industry cluster.

Table 5.1 Industry Clusters Comparison

Rank	Employment 2023	Change in Employment 2013-2023	Average Wage 2023	Cluster Output 2022	Cluster Exports 2022	Export Share of Output
1	Metals & Minerals (306,000)	Transportation equipment & vehicles (29%)	Mining ($96,000)	Chemicals & Plastics ($227 billion)	Transportation equipment & vehicles ($24 billion)	Transportation equipment & vehicles (13%)
2	Transportation equipment & vehicles (230,000)	Chemicals & Plastics (16%)	Machinery ($82,000)	Consumer Products ($220 billion)	Chemicals & Plastics ($20 billion)	Electronics (12%)
3	Consumer Products (204,000)	Consumer Products (9%)	Electronics ($80,000)	Transportation equipment & vehicles ($184 billion)	Electronics ($14 billion)	Machinery (12%)
4	Machinery (192,000)	Machinery (7%)	Chemicals & Plastics ($72,000)	Metals & Minerals ($161 billion)	Machinery ($13 billion)	Mining (9%)
5	Chemicals & Plastics (190,000)	Electronics (5%)	Metals & Minerals ($71,000)	Machinery ($117 billion)	Metals & Minerals ($13 billion)	Chemicals & Plastics (9%)
6	Electronics (123,000)	Metals & Minerals (4%)	Transportation equipment & vehicles ($70,000)	Electronics ($110 billion)	Consumer Products ($10 billion)	Metals & Minerals (8%)
7	Mining (48,000)	Mining (-29%)	Consumer Products ($59,000)	Mining ($88 billion)	Mining ($8 billion)	Consumer Products (5%)

The transportation equipment and vehicles cluster is particularly noteworthy in that it is the second-largest of the export-oriented clusters by employment (230,000 employees), has seen the greatest growth in employment over the last 10 years (29 percent), and has both the greatest total exports ($24 billion in 2022) and highest export share (13 percent). The chemicals and plastics cluster has also seen substantial growth in employment over the past 10 years and is the largest export-oriented cluster by total output and the second-largest exporter. The export-oriented clusters paying the highest wages are also some of the smaller and slower-growing (or in the case of mining, *declining*) clusters. This may, in part, reflect the more specialized nature of employment in

these clusters. While the consumer products cluster is one of the top clusters in total employment, employment growth, and overall economic output, it is worth noting that it is the only export-oriented cluster that pays wages below the regional average. In terms of international markets, Canada and Europe are the top two destinations for Appalachian exports.

Transportation needs for the export-industry clusters vary substantially. Clusters exporting high-value, low-weight products tend to rely more heavily on air transport, while clusters exporting bulkier products rely more on water and/or road transport (depending on the destination market). Electronics, for example, exports more than 45 percent (by value) of its products by air, while chemicals and plastics exports between 31 and 34 percent by air. Clusters relying more heavily on water transportation, such as transportation equipment and vehicles (which exports 50 percent or more by water) may locate their facilities in proximity to key ocean ports, or in proximity to inland ports and waterways that provide access to these ports of exit (such as the Spartanburg BMW plant's siting near Inland Port Greer, thereby providing a freight rail link to the port of Charleston, SC).

In addition to the transportation needs for export activities, industries across Appalachia rely on transportation services. Across the region, industry expenditures on transportation constitute more than three percent of overall regional economic output, with less export-oriented sectors like construction and retail trade demonstrating the crucial role of transportation to their economic activities. In 2022, Appalachian industries spent approximately $96 billion on transportation services – predominantly on truck transport, which made up 87 percent of all expenditures on transportation services.

At the same time, the region has seen a decline in shipments of goods by rail, driven chiefly by decreasing demand for coal. While rail shipments of other commodities (such as electronics, motor vehicles, and petroleum products) have increased, this has not offset the dramatic decline in freight rail volumes. Trucking, on the other hand, has seen extensive growth partly due to the increase in warehousing and distribution center activity, driven by evolving consumer demands, the rise in e-commerce, and the increasing expectation of same-day or next-day deliveries. Employment in this sector has more than tripled since 2001, particularly in areas in proximity to major urban centers and existing highway infrastructure.

5.1. Summary Findings and Potential Next Steps

Building on past research for ARC, including the 2010 Access to Global Opportunity report,[18] this study

[18] Network Appalachia: Access to Global Opportunity, 2010. https://www.arc.gov/report/network-appalachia-access-to-global-opportunity/

highlights a number of interesting findings and potential future studies:

- Despite its inland location, global exports are a critical source of economic activity for Appalachia, contributing approximately $120 billion to the region's economy every year.
- The mix of export-oriented industry clusters in Appalachia has shifted over the past twenty years, with greater emphasis on electronics, chemicals, machinery, and transportation equipment (including autos), with growth led by the South and South Central regions of Appalachia.
- With international destinations including Canada, Europe, Eastern Asia and Mexico, the top ports of exit reflect today's multimodal transportation system with trucking (border crossings), seaports and airports all being essential facilities to link to global markets.
- The substantial value of exports traveling by air to international markets highlights the importance of major airports that are often just outside the Appalachian region such as Atlanta, New York (JFK), Memphis, and Louisville. These shipments typically require a reliable truck trip to airports. Meanwhile, Appalachia has abundant general aviation (GA) airports which could be combined with new technologies for 'advance air mobility' freight shipping solutions – a future opportunity that could be tracked and further studied with regional partners.
- Data on exports, the mode used to ship to a port of exit, and port volumes highlights the value of inland ports providing freight rail connections to Atlantic seaports (e.g., Norfolk, Charleston, Savannah) for Appalachian exporters connecting to global markets. While freight rail is facing significant challenges in Appalachia given the major decline of the leading commodity (coal), there is evidence of growth in rail shipments of goods such as electronics and motor vehicles. And there are examples of short line railroads actively working to link industrial development opportunities to freight rail service.
- Transportation expenditures by Appalachian businesses total almost $100 billion per year, with the growth of trucking and the importance of in-house transportation services highlighted in the data. The growth in freight truck activity is closely related to truck parking issues and the need to expand truck parking capacity and options, along with monitoring the evolution towards electric vehicles.
- Export industries and warehouse distribution facilities are not spread evenly through Appalachia, but rather are located in particular locations highlighting both assets and challenges. For example, the mighty transportation equipment cluster (led by large auto assembly and parts manufacturing) is heavily concentrated in the South, whereas machinery, chemicals and warehousing also have a significant presence in the northern areas of Appalachia. The central areas of the region (for example, in parts of Kentucky and West Virginia) are generally underrepresented in export-oriented clusters and trade activity, reflecting the mountainous terrain and historically weaker transport connections of these areas. One potential area for future study and regional partnership is trying to identify ADHS corridors (especially in central Appalachia) that are currently under-served by warehousing, distribution and truck parking facilities to see if there could be win-win opportunities to boost economic development and help highway facilities realize their potential and intended role (such as when an ADHS corridor is a viable truck route but underutilized when not designated as an interstate).

- Future research studies by ARC could examine supply chain logistics in greater detail, with two interrelated ideas potentially worthy of more in-depth research. First, for the export-oriented industries identified in this report, a study extension could examine the intermediate goods (inputs) required for production of the export clusters. This analysis would evaluate the size of these intermediate purchases, and the location of supplier businesses in Appalachia to map these inter-industry linkages and the transportation linkages between them. Second, further study of international imports could evaluate the role of various seaports, inland ports, airports, highways, inland waterways, and rail to transport imports to Appalachia (to final consumers and as raw materials and intermediate inputs to production).

Appendix

Cluster Identification Methodology

Identify Industry Pool

To focus on export-oriented industries, the pool of industries considered is limited to those associated with traded commodities. These industries are determined using the US Bureau of Transportation Statistics (BTS) Commodity Flow Survey (CFS). The CFS provides a comprehensive, multimodal summary of national freight flows, including data on the type of commodities shipped (defined by two-digit Standard Classification of Transported Goods (SCTG) code) and the NAICS industry of the shippers. These indicators are used to estimate the NAICS industries associated with each commodity. This pool of NAICS industries comprises the industry pool.[19]

NAICS industries in the CFS are defined at the three- to six-digit level. For consistency with other data source, five- and six-digit codes are aggregated to the four-digit level, resulting in a list of 42 industries at the three- or four-digit NAICS level, as seen in Table A.1.

[19] Two industries (warehousing & storage and management offices) were removed from the list because they are related to supply chain logistics rather than a specific good.

Table A.1 Industries Considered in Cluster Analysis

NAICS	NAICS Description	NAICS	NAICS Description
212	Mining (except Oil & Gas)	339	Misc. Manuf.
311	Food Manuf.	4231	Motor Vehicles & Parts Wholesalers
312	Beverage & Tobacco Prod. Manuf.	4232	Furniture & Home Furnishing Wholesalers
313	Textile Mills	4233	Lumber & Other Construction Materials Wholesalers
314	Textile Prod. Mills	4234	Commercial Equip. Wholesalers
315	Apparel Manuf.	4235	Metal & Mineral Wholesalers
316	Leather & Allied Prod. Manuf.	4236	Household Appliances & Electronics Wholesalers
321	Wood Prod. Manuf.	4237	Hardware, Plumbing & Heating Equip. Wholesalers
322	Paper Manuf.	4238	Machinery, Equip., & Supplies Wholesalers
323	Printing & Related Support Activities	4239	Misc. Durable Goods Wholesalers
324	Petroleum & Coal Prod. Manuf.	4241	Paper & Paper Prod. Wholesalers
325	Chemical Manuf.	4242	Drugs & Druggists' Sundries Wholesalers
326	Plastics & Rubber Prod. Manuf.	4243	Apparel, Piece Goods, & Notions Wholesalers
327	Nonmetallic Mineral Prod. Manuf.	4244	Grocery & Related Prod. Wholesalers
331	Primary Metal Manuf.	4245	Farm Prod. Raw Material Wholesalers
332	Fabricated Metal Prod. Manuf.	4246	Chemical & Allied Prod. Wholesalers
333	Machinery Manuf.	4247	Petroleum & Petroleum Prod. Wholesalers
334	Computer & Electronic Prod. Manuf.	4248	Beer, Wine, & Distilled Alcoholic Beverage Wholesalers
335	Electrical Equip., Appliance, & Component Manuf.	4249	Misc. Nondurable Goods Wholesalers
336	Transportation Equip. Manuf.	4572	Fuel Dealers
337	Furniture & Related Prod. Manuf.	5131	Newspaper, Periodical, Book, & Directory Publishers

Evaluate Industries against Criteria

The two criteria industries are measured against are: 1) substantial (i.e., relatively large in terms of employment); and 2) export oriented (measured as both value and share of total output).

Employment Size

To focus the analysis on industries with a substantial presence in Appalachia, this step identifies industries in the top 60th percentile of total employment in 2023. Employment data by county and 4-digit NAICS code were

provided by Mass Economics' data-Fab.[20] Importantly, these data fill in missing data fields (which are common at the county level) to provide reliable, comprehensive employment and wage estimates at the county level. This filter results in 26 industries with over 19,500 employees in Appalachia (seen in Table A.2 below). As part of this filtering process, we also calculated and assessed the location quotients of industries to gauge the industry concentration (compared to United States averages) of identified clusters.

[20] These data are based on the BLS Quarterly Census of Employment and Wages, but employment and wages in small areas are estimated using a sophisticated methodology that combines multiple data sources and data estimation techniques. This approach fills in missing data fields to provide reliable, state-of-the-art employment and wage estimates at the county level. ARC purchased this data for employment and wage data at the 4-digit NAICS level. For more information, visit https://masseconomics.com/data-fab/.

Table A.2 Industries that Qualify based on Employment Levels

NAICS	NAICS Description	Employment 2023
336	Transportation Equip. Manuf.	202,809
332	Fabricated Metal Prod. Manuf.	151,739
311	Food Manuf.	139,101
326	Plastics & Rubber Prod. Manuf.	110,800
333	Machinery Manuf.	102,904
325	Chemical Manuf.	78,944
331	Primary Metal Manuf.	67,272
321	Wood Prod. Manuf.	66,349
337	Furniture & Related Prod. Manuf.	63,928
335	Electrical Equip., Appliance, & Component Manuf.	56,514
4238	Machinery, Equip., & Supplies Wholesalers	55,865
327	Nonmetallic Mineral Prod. Manuf.	48,210
334	Computer & Electronic Prod. Manuf.	47,347
4244	Grocery & Related Prod. Wholesalers	44,389
322	Paper Manuf.	40,119
212	Mining (except Oil & Gas)	39,503
339	Misc. Manuf.	38,642
4234	Commercial Equip. Wholesalers	33,302
313	Textile Mills	33,260
314	Textile Prod. Mills	30,904
323	Printing & Related Support Activities	27,573
4231	Motor Vehicles & Parts Wholesalers	26,851
312	Beverage & Tobacco Prod. Manuf.	26,088
4239	Misc. Durable Goods Wholesalers	24,287
4233	Lumber & Other Construction Materials Wholesalers	19,980
4237	Hardware, Plumbing & Heating Equip. Wholesalers	19,598

Export-oriented

This filter identifies industries with significant export activity (i.e., export-oriented industries). Industries are classified as export-oriented based on export intensity (the share of total output that is exported) or total export value. Specifically, an industry meets this filter criteria if it is in the top 30th percentile for either total export value or export share. Of course, many industries meet both criteria, but only one needs to be met to qualify as export-oriented.

This analysis uses Freight Analysis Framework (FAF) data from the BTS to estimate freight flows exported from Appalachia. These publicly available data provide freight flows for FAF regions, which are clusters of counties. The time series spans 2017 to 2022 and the data are available for each origin-destination pair, allowing for analysis of imports and exports as well as domestic freight flows.

While FAF data offer a detailed and well-vetted source for freight flow information, two issues arise. First, the FAF regions do not align with the Appalachian Region boundaries. To overcome this challenge, we follow the methodology outlined in the 2023 Network Appalachia report,[21] to estimate the freight activity occurring in the region. For each FAF region, we estimate the share of freight activity that occurs within Appalachia and apply that share to the FAF5 freight data estimates. For inbound transactions, where demand is largely driven by population, we use the share of the population living in the Appalachian portion of the region. Alternatively, we use the percentage of employment in freight related industries as a proxy for the share of outbound freight from Appalachian counties.

Second, the FAF data include freight flows by commodity but do not provide information about the industrial classification of enterprises. Since the clusters are defined by NAICS industry, mapping commodities to industries was a necessary step. As discussed above, the BTS Commodity Flow Survey (CFS) provides a bridge between commodities and industries. The survey shows shipments both by commodity and NAICS industry at the three- or four-digit level. We calculate the share of a commodity's shipment value associated with each NAICS industry. We then apply this share to the FAF commodity-level data to map shipments to industries.[22]

As a result of these processing steps, freight flows can be estimated for the Appalachian Region and its subregions at the NAICS level. Using this information, we calculate export value and intensity (share) for each industry. The table below identifies the 15 industries that are export-oriented either in terms of value, share, or both (8 industries bolded in the table below qualify by both metrics).

[21] Cambridge Econometrics, 2023. Network Appalachia: Freight, Trade, and Economic Development. https://www.arc.gov/report/network-appalachia-freight-trade-and-economic-development/.

[22] The most recent CFS available at the time of this report was from 2017. As such, 2017 NAICS codes had to be mapped to 2022 classifications. As part of this process, the electronic shopping and mail-order houses sector was dropped. Prior to calculating NAICS shares for each commodity, two sectors were dropped because they are related to logistics and management rather than the commodities themselves: warehousing and storage and management of companies and enterprises.

Table A.3 Industries that Qualify based on Export Value and Export Intensity

Export Value			Export Intensity		
NAICS	NAICS Description	2022 Export Value (billions $)	NAICS	NAICS Description	2022 Export Share
336	**Transportation Equip. Manuf.**	**$21.55**	**212**	**Mining (except Oil & Gas)**	**25%**
325	Chemical Manuf.	$14.86	**334**	**Computer & Electronic Prod. Manuf.**	**13%**
333	**Machinery Manuf.**	**$9.01**	**336**	**Transportation Equip. Manuf.**	**13%**
334	**Computer & Electronic Prod. Manuf.**	**$8.22**	**339**	**Misc. Manuf.**	**12%**
212	**Mining (except Oil & Gas)**	**$5.93**	**333**	**Machinery Manuf.**	**12%**
326	**Plastics & Rubber Prod. Manuf.**	**$5.02**	4234	Commercial Equip. Wholesalers	11%
332	Fabricated Metal Prod. Manuf.	$4.69	**335**	**Electrical Equip., Appliance, & Component Manuf.**	**11%**
4242	Drugs & Druggists' Sundries Wholesalers	$4.38	4236	Household Appliance & Electronics Wholesalers	11%
335	**Electrical Equip., Appliance, & Component Manuf.**	**$3.77**	**4239**	**Misc. Durable Goods Wholesalers**	**11%**
311	Food Manuf.	$3.63	4238	Machinery, Equip., & Supplies Wholesalers	11%
339	**Misc. Manuf.**	**$3.54**	4246	Chemical & Allied Prod. Wholesalers	11%
322	Paper Manuf.	$3.35	4231	Motor Vehicles & Parts Wholesalers	10%
4239	**Misc. Durable Goods Wholesalers**	**$3.25**	**326**	**Plastics & Rubber Prod. Manuf.**	**10%**

Repeat Process for all Subregions

In some cases, industries that do not meet the evaluation criteria for Appalachia overall meet the criteria for a specific subregion. These industries of subregional importance are also included in the clusters list. The industries that meet the criteria and their respective subregions are listed in the figure below. As a result of the subregional analysis, five industries are added:

- Household Appliances and Electronics Wholesalers
- Nonmetallic Mineral Prod. Manuf.
- Paper Manuf.
- Petroleum and Coal Prod. Manuf.
- Primary Metal Manuf.

Figure A.1 shows which industries meet the evaluation criteria in Appalachia and its four subregions. Highlighted cells indicate that the industry qualifies in the specified area.

Figure A.1 Qualifying Industries by Region and Subregion

Industry	Appalachia	North	North Central	South Central	South
Chemical Manuf.	■	■	■	■	■
Commercial Equip. Wholesalers	■		■	■	
Computer & Electronic Prod. Manuf.	■	■		■	■
Electrical Equip., Appliance, & Component Manuf.	■	■		■	■
Fabricated Metal Prod. Manuf.	■	■	■	■	■
Food Manuf.	■	■		■	■
Household Appliances & Electronics Wholesalers					■
Machinery Manuf.	■	■	■	■	■
Machinery, Equip., & Supplies Wholesalers	■	■	■	■	■
Mining (except Oil & Gas)	■	■	■	■	
Misc. Durable Goods Wholesalers	■	■		■	
Misc. Manuf.	■	■	■	■	■
Motor Vehicles & Parts Wholesalers	■				■
Nonmetallic Mineral Prod. Manuf.			■		
Paper Manuf.				■	■
Petroleum & Coal Prod. Manuf.			■		
Plastics & Rubber Prod. Manuf.	■	■	■	■	■
Primary Metal Manuf.		■	■		
Transportation Equip. Manuf.	■	■	■	■	■

Note: Shaded cells indicate that the industry met the evaluation criteria for the area.

Group Related Industries into Clusters

This process yields 19 industries, defined at the three- or four-digit NAICS level. These industries are grouped into seven clusters based on similar sector activities and goods produced, as shown in the figure below.

Figure A.2 Industries Included in Each Cluster