Appalachian Regional Commission

Network Appalachia: Freight, Trade, and Economic Development







Appalachian Regional Commission



Final Report

July 2023

Cambridge Econometrics Inc Northampton, MA dh@camecon.com www.camecon.us

Prepared for the Appalachian Regional Commission under contract #TRANS 21-04

Acknowledgements

This project was commissioned and funded by the Appalachian Regional Commission (ARC), led by Jim Sinnette. The project was envisioned and guided by Network Appalachia, a multimodal transportation stakeholder advisory group representing all 13 states of Appalachia. The research, analysis, and writing of this report were led by Dan Hodge and Ann Furbush of Cambridge Econometrics.

This study relied on the cooperation and support of many individuals and organizations in the development of freight facility case studies. These include:

- Michael Hoffman, Director of Inland Ports, South Carolina Ports Authority
- Steven Beattie, Executive Director, SEDA-COG Joint Rail Authority
- Terry Hart, President and CEO, Chattanooga Metropolitan Airport Authority
- Tim Gibbs, President/CEO, Ashland Alliance
- Wesley Barrell, Regional Manager of Strategic Operations, Georgia Ports Authority

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1 Background and Purpose

The Appalachian Region stretches from Mississippi to New York, encompassing 423 counties across 13 states. The Region is home to over 26 million people. While Appalachia includes a number of metropolitan areas, such as Pittsburgh, PA, Birmingham, AL, and Chattanooga, TN much of the Region is rural. About one quarter of the counties in Appalachia are neither part of nor abutting a metropolitan area, and about 10 percent of Appalachians live in these rural counties.

Appalachia is rich with resources and opportunities and has made significant progress over the past 50 years.¹ Nonetheless, substantial portions of the Region are characterized by poverty and economic distress. While Appalachia has seen a steady increase in income and educational attainment and decrease in poverty rates over the past few decades, the Region still lags behind national benchmarks. Historically, much of the Region's economy was centered around the coal industry. As the country moves away from fossil fuels, Appalachia is grappling with a changing economy.

Though the commodity mix is changing, freight remains an important pillar of the Region's economic activity. The freight transportation infrastructure system in Appalachia continues to grow and evolve, accommodating growth in freight demand in the area and paving the way for new opportunities. As technology and ecommerce progress, freight in Appalachia continues to adapt. With advanced freight monitoring technology, increased demand for ecommerce and same-day delivery, and autonomous vehicles on the horizon, freight stakeholders must prepare for the future.

Maintaining up-to-date reports of regional and macro-economic trends helps stakeholders in the Region take advantage of economic opportunity, enhance commerce efficiency, and adequately prepare for the future. In 2009, the Appalachian Regional Commission (ARC) completed a study describing the intermodal freight transportation network in Appalachia. The study, entitled "Network Appalachia: Access to Global Opportunity" focused on Appalachia's place in the global freight market and documented regional transport infrastructure and connectivity networks. That effort led to the sustained Network Appalachia multimodal transportation stakeholder advisory group that meets regularly to discuss key freight issues and opportunities. Over a decade later, the study and its supporting data are outdated and no longer represent the everchanging Region.

This report provides an up-to-date assessment of the freight network in Appalachia and the global context that surrounds it. Like the report that precedes it, this study maps freight network connections in the Region, profiles key freight facilities, and describes global

¹ Center for Regional Economic Competitiveness and West Virginia University for the Appalachian Regional Commission, "Appalachia Then and Now."

context and trends. In addition, this study uses a novel methodology to estimate the quantity and value of freight flows and commodity shipments in Appalachia using publicly available data. This study also provides an assessment of freight employment in the Region and thus the economic development contribution of freight and trade sectors in Appalachia.

2 Freight Network and Facilities in Appalachia

This section describes the freight transportation infrastructure system by mode in Appalachia, including highway, aviation, rail, and water-based connectivity. This robust freight network connects Appalachia to regional hubs and global markets.

2.1 Highway

The Appalachian Region is served by numerous major interstate highways as well as US, state and local highways. As seen in Figure 1, part of this highway system comprises the Appalachian Development Highway System (ADHS). ADHS was authorized by Congress with the expressed purpose of stimulating economic activity in Appalachia. About 91 percent of the 3,090-mile network is in use or under construction and the entire system is scheduled to be completed or under construction by 2040. While more highway connections and completions are still in the pipeline, the highway system of Appalachia is now much more effective at stitching together the region and connecting to major East Coast and Midwest markets, ports, and population centers.

2.2 Aviation

Aviation is also an important component of freight movement in Appalachia, particularly for high-value cargo. Cargo airports in Appalachia are generally located near metropolitan areas and usually have quick access to a major highway (see Figure 1). The US Bureau of Transportation Statistics defines cargo airports, and the vast majority align with commercial (passenger) airports. About 40 percent of the cargo airports in the Region are located in Pennsylvania and New York, and a number of major airports are located just outside of Appalachia (e.g., Columbus, Cincinnati, Nashville, and Atlanta).



Figure 1: Highway and Aviation Freight Facilities in the Appalachian Region

Source: Cambridge Econometrics with data from the US Bureau of Transportation Statistics Transportation Maps and Geospatial Data and ARC data on ADHS corridor locations

2.3 Rail

Railroad transport is a common mode for freight moving to, from, and within Appalachia, particularly for bulk shipments. The Appalachian Region is served by several Class I railroads and a large number of regional and short line railroads (see case study in Pennsylvania on page 53). As seen in Figure 2, CSX and Norfolk Southern operate hundreds of miles of rail service throughout the region. Mississippi is the only Appalachian state served by Kansas City Southern. Appalachia is home to an increasing number of key inland rail ports, which are mostly concentrated in the southern portion of the Region. Recent examples of new inland ports include Greer Inland Port in South Carolina and the Appalachian Regional Port in Crandall, Georgia. The central portion of Appalachia, north of Georgia and south of Pennsylvania, does not have any active major inland rail ports or intermodal terminals. However, a number of facilities, like the Virginia Inland Port in Front Royal and intermodal facilities in Chambersburg (PA), are located just outside the region.



Figure 2: Rail Freight Facilities in the Appalachian Region

Source: Cambridge Econometrics with data from the US Bureau of Transportation Statistics Transportation Maps and Geospatial Data

2.4 Water and Inland Waterways

Several major navigable waterways flow through Appalachia and provide opportunities for water-based freight movement. These include the Ohio River, Cumberland River, Tennessee River, and Tennessee Tombigbee River, as seen in Figure 3. These inland waterway routes are a cost-effective way to ship a wide range of bulk commodities such as oil/petroleum, aggregate, coal, etc.

Outside of the Region, a number of major seaports on the Atlantic and Gulf serve as hubs for freight activity and import/export trade logistics. There are also relevant port facilities along the Great Lakes and the St. Lawrence Seaway. Much of the freight traveling into or out of Appalachia, particularly foreign imports and exports, arrives through these seaports.



Figure 3: Appalachian Inland Waterways and Seaports

Source: Cambridge Econometrics with data from the US Bureau of Transportation Statistics Transportation Maps and Geospatial Data

3 Review of State and Regional Freight Plans – Findings and Themes

As part of their transportation planning activities, states are required to develop and publish statewide freight plans. These plans include an overview of relevant freight policy, existing and projected commodity flows, a profile of freight infrastructure and facilities in the state, a summary of the challenges facing statewide freight movement, and plans for freight improvement. While covering more than the Appalachian Region, the plans for the 13 Appalachian states provide insight into the Region's strengths, challenges, trends, and priorities for the future of freight. There are also a wide of regional and metro area freight planning documents, with initiatives spanning several states profiled here. This summary is based on a review the 16 documents shown in Table 1 and provide an overview of common themes and trends.

Source	Year
AL Freight Plan & Plan Summary	2017
GA Freight and Logistic Action Plan	2018
KY Freight Plan	2017
MD State Freight Plan DRAFT	2022
MS Freight Plan Executive Summary	2015
NC Statewide Multimodal Freight Plan	2017
NY Freight Transportation Plan	2019
OH State Freight Plan	2022
PA Comprehensive Freight Movement Plan	2016
PA State Rail Freight Plan	2020
SC Statewide Freight Plan	2020
TN Statewide Multimodal Freight Plan	2019
VTrans 2040 Virginia Freight Element	2017
WV State Freight Plan	2018
Freight Movement along Freight Alley - the Greater Chattanooga Region	2021
Trade, Logistics, and Technology Trends: Southeast Trade and Transportation Study (SETTS)	2022

Table 1: State and Regional Freight Plans Reviewed

Geopolitical impacts

State freight plans discuss several global trends that influence freight movement within their borders. The 2017 widening of the Panama Canal increased the waterway's capacity, accommodating larger vessels and changing international shipping patterns. This update increased the freight volumes traveling to and from major ports along the east coast, which connect to the freight network within Appalachia. Impacts of the geopolitical instability stemming from Russia's invasion of Ukraine also reached the Appalachian Region. Prices of many commodities, such as food products and oil and gas, increased substantially following the invasion and supply chain disruptions have caused delays and put pressure on warehousing space.

SOUTHEAST TRADE & TRANSPORTATION STUDY (SETTS)

In 2022, Cambridge Systematics produced a report summarizing trade, logistics, and technology trends for the Institute for Trade and Transportation Studies (ITTS) member states. Many of these member states overlap with the Appalachian Region, including Georgia, Kentucky, Mississippi, South Carolina, and Virginia. The other five member states included in the report (Arkansas, Florida, Louisiana, Missouri, and Texas) are not in the Appalachian Region but are part of the Southeast's freight network and broader economy. The study is organized around three themes: supply and demand, transportation logistics, and global factors.

Supply and Demand

ITTS states experienced a population growth of about 12 percent between 2010 and 2021. Spurred by this population growth and the rise of e-commerce, freight industry GDP and employment has been on an upward trend, despite setbacks during the Great Recession and Covid-19 pandemic. The Southeast region is highly interconnected, with three-quarters of ITTS tonnage and 54 percent of ITTS freight value contained within the 10 member states in 2017. For international trade by tonnage, the 10-state area is relatively export-heavy (57 percent) whereas international trade by value is more import dominant (55 percent). Some commodities have strong projected growth in the region, including chemicals, gravel, and nonmetallic minerals, whereas others, such as gasoline and coal are projected to decline.

Transportation Logistics

Transportation and logistics trends are driven by advancements in technology and the rise of ecommerce. Freight logistics are experiencing automation of control systems and equipment across all modes, including maritime, rail, and trucking technologies. As e-commerce continues to grow, there has been increased demand for modern warehousing and cross-dock stations to support faster time-to-market and same-day deliveries. Warehousing, distribution, and fulfillment centers have become highly automated. Freight vehicles are also undergoing major technological changes, including electrification and driverless capabilities.

Global Factors

Exports from ITTS states are mostly transported to Mexico and the rest of the Americas, both in terms of values and tons. Alternately, import tonnage mainly comes from rest of the Americas and Asia whereas the highest value comes from Europe and Mexico. The east coast, and Port of Savannah in particular, has seen a rise in imports from Asia as west coast ports become increasingly congested. Global freight continually grapples with uncertainty related to political instability and increased risk of extreme weather events due to global warming.

Evolving manufacturing landscape

Manufacturing, a sector with close ties to freight, has seen a shift in recent years. For many years, manufacturing jobs were outsourced to Asia where labor is relatively cheap. However, these jobs are now "reshoring", or shifting back to the US. Manufacturing in the US is increasingly additive manufacturing, aided by 3D printing advancements and other novel technologies. As manufacturing trends shift, freight must adapt to accommodate the changing industry.

Declining demand for Coal

Appalachia is also grappling with reduced demand for coal, which has historically been a key export for the region, and particularly Kentucky, Virginia, and West Virginia. The coal industry has been declining as the country shifts away from fossil fuels in favor of renewable energy sources. Regions that have depended on coal exports for decades now must find new sources of economic activity.

THE GREATER CHATTANOOGA REGION

The Tennessee Department of Transportation was awarded National Economic Partnership grant funding for a report of freight movement in the Greater Chattanooga Region. The multi-state region encompasses 58 counties across of Tennessee, Georgia, and Alabama, highlighting the importance of inter-state cooperation and planning. The assessment identifies five key freight-dependent industries in the region targeted for future growth: aerospace and aviation: agri-business and food production; automotive; trucking and logistics; and wood products and flooring. These industries employ 1.2 million people in the tri-state region. The study also analyzes truck parking opportunities along highways in the region, noting that truck parking continues to be a significant issue for freight in the area. Driver shortages and highway congestion also pose challenges for trucking in the region. Addressing these issues is increasingly a priority for the region, as truck transportation continues to grow. By 2045, freight tonnage moved by truck is forecast to increase 44 percent in Alabama, 42 percent in Georgia, and 34 percent in Tennessee.

Consumer demand shifts

Population growth, the rise of e-commerce, and increased demand for same-day delivery put pressure on the freight industry to adopt efficiency-enhancing technologies and complete last-mile connections. This has resulted in a significant increase in demand for distribution and warehousing facilities, both large and small. Many states are seeing investment in intelligent transport system technology to help manage freight fleets and warehouses management systems to control warehouse operations. State plans also prioritize last-mile connections to meet the growing demand for same-day delivery, largely driven by Amazon and other online retailers.

Asset management and investment in maintenance

Appalachian states list a number of investment priorities for the near future. The freight network in Appalachian states is limited by aging infrastructure and bottlenecks around urban areas and at rail crossings. Many states cite the need for improved asset management, including upgrades to bridges, locks and dams, roadways, and railways to enhance safety and efficiency. Highway bypasses around congested urban areas is an investment priority listed in many state freight plans.

Truck parking

Like most of the nation, Appalachia is facing a truck parking shortage. Commercial truck drivers struggle to find safe and accessible parking areas to rest along their route.² Providing adequate truck parking opportunities is a priority for states in Appalachia, many of which have completed truck parking studies. In addition, ARC is also commissioning a truck parking study to better understand the issue in the Appalachian Region. The study will identify existing facilities, estimate future parking demand, and develop recommendations to help the region close the gap between supply and demand.³

Autonomous systems

Many states are seeing a shortage of freight workers, particularly truck drivers. To assuage these growing pressures, and reduce the cost of freight transportation, states are planning for a future that includes drone delivery and autonomous vehicles (including trucks and planes). Investment is being funneled into the development of these autonomous systems, though it is not clear when they will become widespread. Autonomous warehouse systems may also become commonplace as technology becomes more sophisticated and affordable.

Climate change and sustainability

Building weather-resilient freight infrastructure is increasingly a priority for states as climate change increases the likelihood and severity of extreme weather events. States are also focusing on environmental sustainability in their freight networks by investing in electric vehicle technology and prioritizing modes of transport with smaller carbon footprints.

² "Truck Parking - FHWA Freight Management and Operations."

³ ARC, "Request for Proposals: Appalachian Region Truck Parking Study."

4 Freight Flows and Commodity Shipments

4.1 Appalachian Freight Flows

Methodology

This section profiles trends and patterns of freight flows in Appalachia. While many sources provide freight data at the state level, the Appalachian Region spans a portion of 12 states, along with the entire state of West Virginia. As such, county-level data are necessary for estimates specific to the Region. However, few sources provide detailed freight data at the county level.

Transearch⁴ is the most comprehensive source for county-level freight flows. However, Transearch data are relatively expensive, especially for such a large region and this option was not feasible for this initial freight analysis update. Transearch data could be considered as a potential next step for ARC.

Alternatively, the Freight Analysis Framework (FAF) provides publicly available freight flow data for FAF regions, which are clusters of counties. Within each state, FAF regions group counties based on major metropolitan areas, with non-metropolitan area counties grouped into a "rest of state" cluster. The latest version of the FAF data, FAF5, provides estimates of tonnage and value for the base year of 2017 with more current annual estimates for 2018 to 2020. Freight data are available for each origin-destination (O-D) pair and include information on commodity type and mode of transportation.

For the purposes of this analysis, we use the publicly available FAF5 data. Because these data are not specific to the Appalachian Region, estimating freight activity for the Region requires the use of a novel approach. 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 percent of the population living in the Appalachian portion of the region. Alternatively, we use the percent of employment in freight related industries as a proxy for the share of outbound freight from Appalachian counties. These freight industries include:

- Rail Transportation
- Truck Transportation
- Warehousing & Storage
- Water Transportation

As an example of how this methodology is applied, there are two FAF regions in Alabama that overlap with the Appalachian Region. One of

⁴ https://www.spglobal.com/marketintelligence/en/mi/products/transearch-freight-transportation-research.html

these FAF regions (metro Birmingham) falls completely within Appalachia, as shown in Figure 4 in dark red. Thus, 100 percent of the freight activity in this FAF region is included in the Appalachian estimates. The other FAF region in Alabama, called "Rest of Alabama", lies partially in Appalachia and partially outside the Region (as shown in Figure 4 in light red). To estimate the freight activity in the Appalachian portion of the "Rest of Alabama" FAF region, we calculate the share of the population or employment (depending on if the commodity shipment is inbound or outbound) in the portion of the FAF region that lies in Appalachia and apply that percentage to the FAF region-level flow data.

Suppose that 100,000 tons of a commodity moved from California to the "Rest of Alabama" FAF region. In this example, county-level population estimates reveal that 60 percent of the population in that FAF region are located in Appalachian Alabama. By applying that portion (60 percent) to the region level inbound amount (100,000 tons), we estimate that 60,000 tons of the commodity are imported into Appalachia. The remaining 40,000 tons of freight movement occurs in other parts of Alabama (outside the Appalachian Region).



Figure 4: Example Freight Flow Estimation in Appalachia

Source: Cambridge Econometrics with data from the US Department of Transportation (DOT) Federal Highway Administration (FHWA) Freight Analysis Framework (FAF).

In the above example, the freight shipment originated in a region completely outside of Appalachia. However, in some cases, both the origin and destination of a shipment fall partially within the Appalachian Region. In these cases, the shipment is separated into four distinct categories:

Domestic inbound

- Domestic outbound
- Within Appalachia
- Outside Appalachia

The portion of the total freight shipment (S) in each of these categories is calculated based on 1) the percent of the origin region within Appalachia (OA); 2) the percent of the origin region outside Appalachia (100%-OA); 3) the percent of the destination region within Appalachia (DA); and 4) the percent of the destination region outside Appalachia (100% - DA):

Domestic inbound = S * (100% - OA) * DADomestic outbound = S * OA * (100% - DA)Within Appalachia = S * OA * DAOutside Appalachia = S * (100% - OA) * (100% - DA)

Building on the above example, suppose the 100,000 tons of freight instead originated in the "Rest of Virginia" FAF region, where 30 percent of the employment in freight industries occurs in the Appalachian portion of the FAF region. In this example, S = 100,000 tons, OA = 30% and DA = 60%, so the freight shipment that falls in each category is estimated as follows:

Domestic inbound = 100,000 tons * (100% - 30%) * 60% = 42,000 tons **Domestic outbound** = 100,000 tons * 30% * (100% - 60%) = 12,000 tons **Within Appalachia** = 100,000 tons * 30% * 60% = 18,000 tons **Outside Appalachia** = 100,000 tons * (100% - 30%) * (100% - 60%)= 28,000 tons

To estimate the share of the population in the Appalachian portion of the FAF regions, we use county-level annual population estimates from the US Census Bureau. To estimate the share of freight industry employment in Appalachia, we use county-level employment estimates from Mass Economics data-Fab at the 3-digit NAICS level (for more information on this data source, see the *Employment in Freight Industries* section). Freight flows in which Appalachia is neither the origin nor final destination (i.e., "through" flows) are excluded.⁵

This method allows us to provide estimates specific to the entire Appalachian Region (and sub-regions). We rely on the assumption that the population and employment shares in Appalachia represent the relative size of the economy. While these indicators are reasonable proxies for freight activity in the area and should provide solid estimates at the large-scale regional level, it is difficult to know

⁵ One implication of this is that the data and methodology doesn't capture through-traffic – goods movement that travels through Appalachia but doesn't have an origin or destination in the Region. One potential advantage of a Transearch data purchase would be to capture through-traffic, which can be substantial.

how much error this assumption introduces, especially for areas with more freight or trade intensive uses such as a port.

Total Freight Flows Applying the above methodology, it's estimated that between 2017 and 2019, over 2 billion tons of freight moved to, from, or within Appalachia each year (see Figure 5). In 2020, this number declined to about 1.9 billion tons. Freight in Appalachia was worth about \$2.3 trillion each year between 2017 and 2019, then dropped to less than \$2.2 trillion in 2020. Like much of the world, freight flows in Appalachia declined in 2020 during the COVID-19 pandemic, and indications are that freight and economic activity rebounded in 2021. Because of the anomaly of the pandemic in 2020, the remainder of this report focuses on 2019 data, which is more representative of a typical freight year.





Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Value estimates are reported in 2017 constant dollars, as provided by FAF5 data.

As seen in Figure 6, about 730 million tons of freight worth about \$990 billion was shipped inbound to Appalachia in 2019. Outbound shipments were almost equal to inbound, though Region had a slight net inflow of goods (about 6 million more tons and \$66 billion more value brought into the region than was shipped outbound). A substantially smaller amount of freight moved within Appalachia than was brought inbound or shipped outbound in 2019. This difference is slightly notable in terms of weight (about 120 million less tons) but substantially different in terms of value (about \$600 billion less in value). This result indicates that freight moving within Appalachia tends to be relatively heavy but have low value whereas freight moving into or out of the Region is worth more per ton.



Figure 6: Freight Flows in Appalachia in 2019

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5).

Most of the tons and value of freight in Appalachia in 2019 were from domestic shipments within the US (see Figure 7). Shipments within Appalachia had around the same tonnage as domestic inbound and outbound shipments. However, the value of freight that moved within the Region was about half of that shipped inbound to or outbound from domestic locations. This result again demonstrates the relatively high weight relative to value of freight moving within the Region. Foreign imports and exports accounted for a substantially smaller portion of freight movement in Appalachia in 2019. Foreign exports accounted for a larger portion of tonnage than imports, while the opposite was true in terms of value. Thus, foreign imports had a relatively high value per ton compared to exports.



Figure 7: Tons and Value of Freight Flows in Appalachia in 2019

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Value estimates are reported in 2017 constant dollars, as provided by FAF5 data.

Freight Flows by Commodity

Gravel and coal are the largest freight commodities in the Appalachian Region in terms of tons moved (Figure 8). In 2019, 290 million tons of gravel and 258 million tons of coal were transported to, from, or within the Region. Compared to 2017, gravel shipments increased by over 20 million tons. At the same time, coal shipments declined by over 20 million tons, demonstrating the downward trend in the industry. About 41 percent of gravel tonnage in Appalachia had both an origin and destination in Appalachia. Coal primarily moved within Appalachia or outbound from the Region (over 100 million tons each). Appalachia was a net importer (from foreign and domestic origins) of base metals, other foodstuffs, and cereal grains.



Figure 8: Freight Flow in Appalachia for the Top Ten Commodities by Tonnage and Value in 2019

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Value estimates are reported in 2017 constant dollars, as provided by FAF5 data.

Appalachia's top commodities in terms of value are an entirely different set of goods. In 2019, motorized vehicles had the largest inbound commodity value (about \$102 billion). Motorized vehicles were also one of the top outbound commodities from the region, along with mixed freight (\$95 billion each). Appalachia had a net inbound flow of nine of its top ten commodities (apart from mixed freight which had a net outflow of \$20 billion). In most cases, this deficit was fairly small (within \$12 billion), with the exception of electronics which had a \$34 billion net inflow. Other top commodities by value include pharmaceuticals, machinery, electronics, and plastics/rubber.

Freight Flows by Mode

Domestic freight is primarily transported by truck. As shown in Figure 9, about 570 million tons (78 percent) of domestic freight moving inbound to or outbound from Appalachia in 2019 was transported by truck. Truck is also the most common mode of transport for freight moving within Appalachia. About 500 million tons of freight moved by truck within the Appalachian Region in 2019 (82 percent of total within Appalachia shipments). The second most common mode of transport by freight tonnage is rail. About 153 million tons of freight was shipped by rail to domestic inbound and outbound locations, accounting for about 10 percent of inbound and outbound shipments by tonnage. Multiple modes (including truck) and water also comprising measurable totals by tonnage.

Foreign imports and exports (not shown in the figure) account for a smaller portion of freight flows in the region. Movement of these goods is mainly via water (71 percent of imported tons, 86 percent of exported tons) as the goods use various seaports for global gateways.



Figure 9: Domestic Freight Flow Tonnage in Appalachia by Mode

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Truck transportation also accounted for the highest share of freight movement by value in 2019 (see Figure 10). About \$770 billion of



Figure 10: Domestic Freight Flow Value in Appalachia by Mode

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Value estimates are reported in 2017 constant dollars, as provided by FAF5 data.

freight moved inbound to the Appalachian Region by truck, and another \$730 billion of freight moved outbound from the Region. Relative to inbound and outbound transactions, a smaller amount of the value moved within Appalachia in 2019 (about \$310 billion). Comparing the value to the tonnage in Figure 9 shows that inbound and outbound freight movements have a higher value per ton than shipments within Appalachia. It's difficult to interpret the finding about 'multiple modes' except that it is clearly the 2nd highest value of shipments and likely includes truck plus another mode. The rail share by value is lower than for tonnage, but air is now measurable as air freight tends to have a very high value per ton.

Water was the most common mode for foreign imports and exports (not shown in the figure) in terms of value, followed by air, as international shipments tend to use major seaports and airports. About 52 percent of imported value and 45 percent of exported value traveled to/from the US via water in 2019. About 28 percent of the total value of exports and imports was shipped via air. At the same time, freight shipped by air only accounted for 4 percent of imported tons and less than 1 percent of exported tons, consistent with the finding that commodities shipped by air were high value and relatively lightweight items.

4.2 Freight Flows in Appalachian Subregions

Methodology

The Appalachian Region spans a broad area, characterized by different freight demand profiles, regional specializations, and natural resource endowments. As such, observing trends in subregions can provide a more nuanced understanding of freight movement in the Region. For this analysis, the Appalachian Region is divided into four subregions defined by state boundaries, as seen in Figure 11.⁶



Figure 11: Appalachian Subregions Map

Source: Cambridge Econometrics

The methodology for this subregional analysis is very similar to the methodology used for the entire Appalachian Region. We distribute FAF5 data to subregions based on the share of population (for inbound shipments) or freight industry employment (for outbound shipments). For the subregional analysis, a freight shipment from the Birmingham, Alabama FAF5 region (completely within the Appalachian Region) to West Virginia (also within Appalachia) counts as a domestic outbound shipment from the South subregion and a domestic inbound shipment to the North Central subregion (rather than a within Appalachia transaction, as before). If the shipment was

⁶ These subregional groupings are similar to the regions shown on ARC's website (<u>https://www.arc.gov/about-the-appalachian-region/</u>) but modified to align with state boundaries.

from a FAF region only partially in Appalachia, a portion of that shipment, based on population of freight employment, would be considered outside of the Appalachian Region (as before).

Total Freight Flows by Subregion

The North subregion of Appalachia, which encompasses portions of New York, Pennsylvania, and Ohio (and includes Pittsburgh – the Region's largest metro area), had the most freight flows inbound, outbound, and within the subregion in 2019 in terms of tonnage (see Figure 12). The subregion has a net inflow of goods in terms of weight, with 92 million more tons brought into the subregion than shipped from the area that year. Alternatively, the North Central and South Central subregions had a net outflow of 64 and 21 million tons, respectively. The South subregion had almost the same amount of inbound and outbound tons (about 240 million tons).





Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5).

In terms of value, the North and North Central subregions were net importers (see Figure 13: Value of Freight Flows in Appalachia by Subregion, 2019. The North subregion received \$58 billion more into the region than it shipped out, while the North Central subregion's net imports were \$35 billion. Conversely, the South and South Central subregions were net exporters, with \$8 billion more inbound freight than outbound in the South and \$19 billion more in the South Central subregion.



Figure 13: Value of Freight Flows in Appalachia by Subregion, 2019

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5).

The North region of Appalachia had the highest value of inbound transactions, with \$378 billion of freight shipped into the region in 2019 (as seen in Figure 13). However, despite the North subregion's higher amount of outbound tonnage (seen in the previous figure), the South subregion had a higher value of outbound freight than the North (\$350 billion compared to \$320 billion). As such, the freight moving outbound from the South had a higher value per ton than freight shipped from the North subregion. Alternatively, freight movement to, from, and within the North Central subregion had relatively low value for inbound, outbound, and within transactions.

Freight Flows by Subregion and Commodity

One key way in which the four subregions differ is in their commodity mix. Subregions specialize in commodities based on their natural resource endowments, workforce skills, and other industrial mix factors. As displayed in Figure 14, in the North subregion, the largest inbound commodity in terms of tonnage was coal, with over 50 million tons in 2019. Gravel was also imported into the subregion (32 million tons) and was the commodity most transported within the subregion (44 million) and outbound from the subregion (25 million) in terms of tons. The top commodities in the North subregion in terms of value are an entirely different set of goods. Pharmaceuticals were the subregion's biggest inbound commodity in terms of value in 2019 (almost \$40 billion). Pharmaceuticals were also a key outbound commodity (\$33 billion), along with mixed freight (\$35 billion). About \$15 billion worth of mixed freight was also moved within the subregion in 2019. Machinery, electronics and motorized vehicles are also some of the subregion's top commodities in terms of value. The region is a net importer of each of these three commodities in terms of value, contributing to its overall net inbound flow of freight value seen in Figure 13.



Figure 14: Tons and Value of Freight Flows in the North Subregion for the Top Ten Commodities in 2019

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Value estimates are reported in 2017 constant dollars, as provided by FAF5 data.

The North Central subregion is much more specialized than the North in terms of tons of freight movement. As discussed above, the North Central subregion is a net exporter in terms of tonnage. As shown in Figure 15, this net outflow is largely due to the area's specialization in coal production. About 106 million tons of coal were shipped outbound from the subregion in 2019, about 94 million more tons than the next largest outbound commodity (gravel, 12 million tons). About 41 million tons of coal were also moved within the North Central subregion in 2019. Gravel was the subregion's largest inbound commodity in terms of tonnage (21 million tons). As discussed above and shown in Figure 13, the North Central subregion is a net importer (from domestic and international sources) in terms of freight value. The subregion's top commodities driving this result included mixed freight, electronics, pharmaceuticals, motorized vehicles, miscellaneous manufacturing products, and machinery, each with over \$2 billion more in inbound shipments than outbound (for mixed freight and electronics, this difference was about \$7 billion). At the same time, pharmaceuticals, machinery, and motorized vehicles were also the subregion's largest outbound commodities in terms of value (over \$7.5 billion each) and the area had a large net outflow of coal. Gasoline was the commodity most moved within the subregion in 2019 in terms of value (about \$5 billion).



Figure 15: Tons and Value of Freight Flows in the North Central Subregion for the Top Ten Commodities in 2019

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5). Value estimates are reported in 2017 constant dollars, as provided by FAF5 data. Freight tonnage in the South Central subregion is dominated by gravel (see Figure 16). In 2019, gravel accounted for the most inbound (20 million), outbound (29 million), and within (30 million) tons in the subregion. Coal was the second largest commodity in the subregion in terms of tonnage, with about 15 million tons traveling inbound and 13 million tons outbound.



Figure 16: Tons and Value of Freight Flows in the South Central Subregion for the Top Ten Commodities in 2019



The South Central subregion's top outbound commodity in 2019 in terms of value was mixed freight (\$33 billion) followed by motorized vehicles (\$21 billion) and machinery (\$20 billion). The largest imported commodities in terms of value were electronics (\$25 billion), motorized vehicles (\$24 billion) and pharmaceuticals (\$24 billion). A smaller value of freight was moved within the subregion, led by mixed freight worth \$7 billion. The South subregion has a distinctly different mix of commodities than other subregions with substantial shipments of logs and waste/scrap but a relative lack of coal. In the South subregion, the top three commodities in terms of tonnage were the same for inbound, outbound, and intra-region freight flows in 2019: gravel (64 million total tons), logs (63 million total tons), and nonmetal mineral



Figure 17: Tons and Value of Freight Flows in the South Subregion for the Top Ten Commodities in 2019



products (49 million total tons). As seen in Figure 17, base metals and coal were also major inbound commodities to the subregion (14 million tons each).

In terms of value, the South subregion's major outbound commodity is motorized vehicles, driven by the regions significant auto assembly industry in South Carolina, Alabama, and Mississippi. The subregion shipped \$57 billion worth of motorized vehicles to final destinations around the world in 2019. At the same time, about \$44 billion worth of the commodity traveled inbound to the subregion and \$28 billion traveled to destinations within the South subregion. In total, \$129 billion of motorized vehicles moved into, out of, or within the subregion. Other major outbound commodities in terms of value included mixed freight (\$32 billion) and pharmaceuticals (\$31 billion). Inbound freight included machinery (\$30 billion) and electronics (\$31 billion).

Freight Flows by Subregion and Mode

As discussed above, the vast majority of domestic freight movement in Appalachia is by truck. However, this result varies substantially by subregion. About 82 to 85 percent of freight tonnage was moved by truck in the North, South Central, and South subregions in 2019 (see Table 2). However, in the North Central subregion, which includes portions of Maryland and Kentucky and all of West Virginia, only about 58 percent of freight was moved by truck. In this subregion, a much higher portion of freight tonnage was moved by rail (18 percent compared to 8 to 10 percent in other subregions) and water (22 percent compared to 1 to 6 percent in other subregions). As evidenced by the high levels water transportation, the North Central subregion takes advantage of its access to the Ohio River along the West Virginia border and its tributaries throughout the area. Alternatively, other subregions utilize multiple modes of transportation more frequently than the North Central area (4 to 6 percent compared to 2 percent).

Mode	North	North Central	South Central	South
Air	0.02%	0.02%	0.09%	0.03%
Multiple	4.06%	2.32%	5.62%	5.44%
Other	0.07%	0.07%	0.01%	0.00%
Rail	7.94%	18.19%	8.26%	9.77%
Truck	81.79%	57.80%	84.89%	82.58%
Water	6.12%	21.60%	1.12%	2.18%

Table 2: Share of Freight Movement Tonnage in 2019 by Mode and Subregion

Note: This table displays domestic movement of freight. For foreign imports and exports, the mode of transit for entry into or out of the US is not displayed but movement within the US is included.

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5).

The share of freight value by mode of transport is more uniform across the subregions than tonnage. As seen in Table 3, in each subregion, about 77 to 82 percent of freight value was transported by truck in 2019. Multiple modes of transit accounted for 13 to 16 percent of freight value while rail lines carried 2 to 5 percent of each subregion's freight value. For the North Central subregion, the low values of freight moving by rail and water relative to tonnage suggests that freight moved via these modes had very low value per ton.

Mode	North	North Central	South Central	South
Air	1.61%	2.74%	2.30%	1.64%
Multiple	16.48%	13.94%	13.10%	15.33%
Other	0.02%	0.00%	0.01%	0.05%
Rail	1.87%	4.40%	2.61%	4.77%
Truck	79.65%	76.59%	81.65%	77.47%
Water	0.36%	2.32%	0.34%	0.74%

Table 3: Share of Freight Movement Value in 2019 by Mode and Subregion

Note: This table displays domestic movement of freight. For foreign imports and exports, the mode of transit for entry into or out of the US is not displayed but movement within the US is included.

Source: Cambridge Econometrics with data from the US Department of Transportation Federal Highway Administration Freight Analysis Framework Version 5 (FAF5).

4.3 Ohio River Inland Waterways

The Ohio River is one of the main inland waterways for freight transportation in Appalachia. Across Ohio, Kentucky, West Virginia, and Pennsylvania, the river is divided into four port statistical areas (PSA), as shown in Figure 18. This section briefly describes the freight





Source: Cambridge Econometrics

movement in these port areas based on data provided by the Army Corps of Engineers.⁷

In the northeastern two PSAs (the Port of Pittsburg and Mid-Ohio Valley Port), coal is by far the largest commodity in terms of tons shipped (see Figure 19). An average of about 39 million tons of coal moved through the two PSAs each year between 2017 and 2021. About 84 percent of this coal tonnage moved outbound from the PSAs to other locations. About 9 million tons of aggregates were received by the two PSAs, making it the largest inbound commodity in terms of tonnage.





Note: The figure displays the average tons and value between 2017 and 2021. Source: Cambridge Econometrics with data from US Army Corps of Engineers Waterborne Commerce Statistics Center (WCSC) dataset.

Petroleum surpassed coal in terms of total value at the two port areas due to its relatively high price per ton. An average of \$2.4 billion of petroleum traveled to or from the two PSAs each year between 2017 and 2021. A slightly higher portion of petroleum value is shipped out of the ports than is received into them (about 56 percent). The value of coal moving through the ports totaled \$1.9 billion. About 84 percent (\$1.6 billion) of this value was shipped from the ports, making it the port's largest outbound commodity in terms of value. Other key commodities shipped in this segment of the Ohio River include iron/steel, chemicals, grains, and ores/minerals.

⁷ Commodity values were estimated from a 2019 commodity valuation study conducted by North Dakota State University's Upper Great Plains Transportation Institute and indexed by PPI to the 2021 price level.

Coal is also a key commodity at the Cincinnati and Northern Kentucky and Huntington Tristate PSAs, as seen in Figure 20. However, unlike the northeastern ports, coal is primarily an inbound commodity for these southwestern ports. About 28 million of the 37 million tons was received by the ports. Alternatively, the next largest commodity in terms of weight, petroleum, is primarily shipped outbound from the ports (66 percent). The Maraton Petroleum Corporation facility located at the tri-state border in the Huntington



Figure 20 Cincinnati and Northern Kentucky & Huntington Tristate Average Tons and Value by Commodity

Note: The figure displays the average tons and value between 2017 and 2021. Source: Cambridge Econometrics with data from US Army Corps of Engineers Waterborne Commerce Statistics Center (WCSC) dataset.

port region is a major contributor to the petroleum industry in this area (see Section 6.3 for more information on this facility).

Like the port areas to the northeast, petroleum is also the highest value commodity moved through the Ports of Cincinnati and Northern Kentucky and Huntington Tri-State areas. About \$7.4 billion of petroluem moved through the port areas each year between 2017 and 2021. About 68 percent of the value is shipped outbound via the region's river ports. Alternatively, the next three highest value commodities, coal, chemicals, and iron/steel, are primarily inbound goods received via the river ports.

5 Employment in Freight Industries

Beyond goods movement and trade, freight transportation industries and services generate jobs, wages and economic development activity. This section describes Appalachian trends in employment and wages in four freight industries:

- Rail Transportation
- Truck Transportation
- Warehousing & Storage
- Water Transportation

For these industries, this section describes the relative concentration of freight jobs in Appalachia as well as freight employment and wage trends in the Region. The distribution of freight jobs across states and subregions within Appalachia is also included in this section.

Data Description

Compiling a consistent data set of detailed industry employment across 423 counties, where only one state is entirely within Appalachia, is not easy. To protect the privacy of individuals and businesses, publicly available three-digit NAICS code employment data at the county level are restricted for many counties. For example, relevant US Bureau of Labor Statistics (BLS) employment data for counties with small populations are often not disclosed. Given the county-based and largely rural nature of the Appalachian Region, this restriction impedes the reliability and usefulness of these data.

To overcome this limitation, we use county-level employment and wage estimates from Mass Economics data-Fab. 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.⁸ 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 the 21-year period of 2001 to 2021. Employment and wage data were provided at the 3digit NAICS level.⁹

The data-Fab team makes some important adjustment to rail transportation employment data. Rail transportation data are unique in the way they are collected and reported as railroad employees are not part of the US Social Security system but rather operate under

⁸ For more information, see <u>https://masseconomics.com/data-fab/</u>

⁹ Data-Fab's truck transportation employment numbers may seem low compared to other sources. This result is because many sources, including the US Bureau of Economic Analysis, count proprietors as employees, accounting for 20 percent or more of overall employment in some cases. Excluding proprietors from employment counts is important because: 1) BEA proprietor counts also include partners and corporate directors; 2) proprietors can have multiple Schedule Cs and thus be counted multiple times; 3) unlike employment, counts are not normalized over 12 months, but are counted the same whether someone is a proprietor for 1 day or 360 days; and 4) many of these Schedule Cs are for short-term work, and not what is typically considered a job. As such, data-Fab's estimates provide a more accurate count of employment in this sector.

the Railroad Retirement Board.¹⁰ The data-Fab data overcome these issues and provide reliable results using a unique method of estimation for the sector.¹¹

5.1 Employment in Appalachia

About 270,000 Appalachians were employed in freight industries in 2021. As seen in Table 4, about half of these workers were employed in the truck transportation sector, and another 44 percent worked in warehousing and storage. Relatively fewer people worked in rail transportation (5 percent) and water transportation (less than 1 percent).

In total, freight transportation jobs accounted for about 3.2 percent of the Region's total employment. Despite this relatively modest share of overall employment, Appalachia has a relatively high concentration of freight jobs. To demonstrate this finding, location quotients (LQ) compare the industry concentration in the Region and the US. Location quotients are calculated by dividing an industry's share of employment in the Region by the industry's share of employment in the US overall. This measure indicates the relative employment concentration of the industry, with a score of one indicating an equal portion of employment in the industry in the Region and the US. A score above one implies that a relatively high portion of workers in the Region are employed in the industry.

The LQ for freight industry employment overall in Appalachia relative to the US is 1.15, indicating that a relatively high portion of the workforce in Appalachia is employed in freight industries. This result is driven by the high concentration of workers in truck transportation (LQ of 1.32) and rail transportation (1.22). Employment in the warehousing and storage industry is about in line with the US overall (LQ of 1.03). Despite its active inland waterways, Appalachia has a relatively small share of employment in water transportation (LQ of 0.36) because the Region does not contain a major seaport.

¹⁰ Whitman, "Research."

¹¹ Data-Fab also develops estimates for annual payroll in the rail industry between 2001 and 2021. They start with creditable compensation plus an add-on to distribute the wages over the cap (payroll in excess of the creditable compensation is given at the national level). For 2001-2010 state creditable compensation is imputed using state-based regression models and adjusted with the add-on for wages over the cap, as described above. All data for 2021 is projected. The resulting annual statewide wage per job is used to estimate county payroll for all counties in that state-year. Given that rail transport is a highly unionized industry, statewide wages are expected to be a reliable proxy for county wages.

Sector	Employment	Percent of total employment in Appalachia	Location Quotient
Rail Transportation	12,268	0.15%	1.22
Truck Transportation	135,744	1.61%	1.32
Warehousing & Storage	119,436	1.42%	1.03
Water Transportation	1,448	0.02%	0.36
Total Freight Industry Employment	268,896	3.20%	1.15
Total Employment in Appalachia	8,408,130	100.00%	

Table 4: Employment in Freight Industries in Appalachia in 2021

Source: Cambridge Econometrics with county level employment data from Mass Economics data-Fab at the 3-digit NAICS level

Employment in freight industries has grown faster than overall employment in Appalachia, but lagged behind freight employment growth in the rest of the country. As seen in Figure 21, like the rest of the country, Appalachian employment in freight industries grew rapidly between 2003 and 2007 before falling during the Great Recession. Following the recession, employment in freight industries in Appalachia increased by 25 percent between 2009 and 2019 while total employment in the Region only grew by 11 percent, indicating the growing importance of freight and logistics in the Region. However, freight employment in the US during that time period increased by substantially more, almost 60 percent.



Figure 21: Employment Growth Index in Appalachia - Total and Freight Industries

Source: Cambridge Econometrics with county level employment data from Mass Economics data-Fab at the 3-digit NAICS level

Unlike the 2008 recession, freight industries were much less impacted than the rest of the economy during the 2020 recession. During the Covid-19 pandemic in 2020, freight employment in Appalachia held steady while overall employment in the Region fell by 6 percent. Freight employment in the country overall continued to see rapid growth during that time, as demand recovered and ecommerce increased as a result of the pandemic



Figure 22: Employment Growth Index in Appalachia - Total and Individual Freight-Industries

As seen in Figure 22, the growth in freight employment over this period was due to the fast pace of growth in the warehousing and storage sector. Employment in this sector more than tripled between 2001 and 2021, growing from about 38,000 to over 119,000. At the same time, employment in rail, trucking, and water transportation fell by 40, 8, and 10 percent, respectively.

The average annual wage in freight industries is generally higher than non-freight industries. As seen in Figure 23, the average annual wage in freight industries was about \$55,000 in 2021, compared to \$53,000 in non-freight industries. While wages in both freight and non-freight industries grew between 2001 and 2021, non-freight wages grew at a slightly faster pace, narrowing the difference in wages from about \$3,900 to \$1,900. In total, payroll in freight industries accounted for about 3.3 percent of the total payroll in

Source: Cambridge Econometrics with county level employment data from Mass Economics data-Fab at the 3-digit NAICS level

Appalachia (just slightly above the share of freight employment in the Region shown in Table 4).



Figure 23: Average Annual Wages in Freight and Non-Freight Industries in Appalachia

Note: This figure shows nominal (not inflation-adjusted) wages. Source: Cambridge Econometrics with county level employment and payroll data from Mass Economics data-Fab at the 3-digit NAICS level

Within freight industries, some sectors are associated with higher wages than others. As seen in Figure 24, jobs in rail and water transportation (which account for a relatively small portion of total



Figure 24: Average Annual Wages in Four Freight Industries in Appalachia

Note: This figure shows nominal (not inflation-adjusted) wages.

Source: Cambridge Econometrics with county level employment and payroll data from Mass Economics data-Fab at the 3-digit NAICS level freight employment) are generally higher paid (over \$80,000 per year) than warehousing and storage and trucking industry jobs (which account for most freight employment). In 2021, truckers earned about \$60,000 while warehousing and storage workers earned about \$45,000.

5.2 Freight Employment in States and Subregions

Freight employment varies substantially by subregion. As shown in Figure 25, the North and South subregions had the most freight employment in 2021, each accounting for about a third of the total freight employment in the Region. About 65,000 workers were employed in freight industries in the South Central subregion (about 24 percent of the total employment in the Region). A substantially smaller share of Appalachian freight employment comes from the North Central region (about 8 percent).



Figure 25: Freight Industry Employment in Appalachian Subregions in 2021

Source: Cambridge Econometrics with county level employment and payroll data from Mass Economics data-Fab at the 3-digit NAICS level

As shown in Figure 26, the North and South subregions each had over 40,000 employees in the trucking and warehousing and storage sectors in 2021. The North Central subregion has substantially lower employment in these two sectors than other areas. Truck transportation has more employment than warehousing and storage in every subregion except the North, where the two sectors employ about the same number of people (44,000).



Figure 26: Employment in Truck Transportation and Warehousing in Appalachia in 2021 by Subregion

Source: Cambridge Econometrics with county level employment data from Mass Economics data-Fab at the 3-digit NAICS level

As discussed above, bulk freight industries such as rail and water transportation employ a smaller number of people in Appalachia (12,300 and 1,400 total workers, respectively). As seen in Figure 27, in 2021, the North subregion accounted for the most employment in rail transportation (4,500 jobs) followed by the South (3,200). The North Central subregion, which includes Ohio River ports in West Virginia and Kentucky, had the highest employment in water transportation (630 jobs).

In total across the four freight industries, the North subregion had the most freight employment in 2021 (93,000), followed by the South (89,000). Meanwhile the South Central subregion had 65,000 freight employees and the North Central subregion employed about 22,000 people in freight industries.



Figure 27: Employment in Rail and Water Transportation in Appalachia in 2021 by Subregion



The freight industry data by county also allows for an assessment of Appalachian employment by state. As seen in Figure 28,



Figure 28: Employment in Truck Transportation and Warehousing in Appalachia in 2021 by State

Note: I his figure shows employment in two freight industries for counties within the Appalachian Region.

Source: Cambridge Econometrics with county level employment data from Mass Economics data-Fab at the 3-digit NAICS level

Pennsylvania has the highest number of employees in truck transportation and warehousing and storage. This state accounted for the majority of the North subregion's employment in 2021 in truck transportation (70 percent) and warehousing and storage (84 percent). The next five states with the most truck and warehousing and storage employment in 2021 are Tennessee, Georgia, Alabama, North Carolina, and South Carolina, which all fall within the South and South Central subregions.

Pennsylvania also has the highest employment in rail transportation in Appalachia (Figure 29). In 2021, over 3,000 people worked in the sector in Pennsylvania, almost double the next highest state (Alabama with about 1,600 rail transportation workers). Pennsylvania also has one of the highest employment levels in water transportation (320 employees), along with Kentucky (330 employees), West Virginia (300 employees) and Alabama, (270 employees).



Figure 29: Employment in Rail and Water Transportation in Appalachia in 2021 by State

Note: This figure shows employment in two bulk freight industries for counties within the Appalachian Region.

Source: Cambridge Econometrics with county level employment data from Mass Economics data-Fab at the 3-digit NAICS level

6 Lessons Learned from Key Freight Logistics Facilities

This section explores five freight facility case studies in the Appalachian Region. These case study overviews provide insight into the operations and trends at Appalachian freight facilities and regional economic impacts of freight. Each facility covered in this section is generally considered a success story for freight in the Region and sets an example for future freight facility and logistics development, including ideas about the conditions, funding and partnerships necessary for successful freight logistics facilities.

6.1 Inland Port Greer, South Carolina

Background

Inland Port Greer is an inland rail port located four miles from I-85 in northern South Carolina, between Charlotte, North Carolina and

Atlanta, Georgia. This location places the port within a one-day truck trip of 94 million consumers. With daily rail trains to and from the Port of Charleston 212 miles to the southeast. the inland port provides an efficient connection to



the seaport and a greener alternative to trucking. The port is owned and operated by South Carolina Ports Authority (SC Ports) and served exclusively by Class 1 railroad Norfolk Southern.

Inland Port Greer features 47 acres of paved yard and three 2,600 foot tracks. The port also has five 2,600 foot storage tracks and a chassis yard on site. Equipment at the port includes five rubber-tired gantry cranes, one toplifter, and three empty handlers.

The construction of the inland port cost just under \$50 million. About \$40 million of the funding to construct the inland port came from SC Ports and about \$7 million was funded by Norfolk Southern. Since opening its doors in 2013, the port has seen great success. The number of lifts at the port increased by 328 percent between 2014 and 2022, despite a setback in freight movement during the 2020 Covid-19 pandemic. The port's success inspired the creation of

another inland port to serve the eastern Carolinas – Inland Port Dillon, located on I-95 and served by CSX, began operation in 2018.

Operations and Activities

BMW is the port's anchor customer and was a significant factor in the decision to locate in the area. The manufacturer produces over 200,000 finished cars each year and remains the primary user of the port, accounting for about two thirds of the total volume. The car manufacturer is export dominant, largely due to its sale of kit cars to foreign



markets. Until recently, Russia was a key buyer of BMW cars. However, BMW stopped exporting to the country after its invasion of Ukraine in 2022.

Exclusively serviced by Norfolk Southern, Inland Port Greer operates express service to and from the Port of Charleston six days per week. The port operates a roughly 50/50 inbound/outbound flow of containers and has 24/7 gates and next-day container availability. The number of lifts at the port grew from 42,500 in 2014 to over 160,200 in 2021, almost quadrupling during the 7-year period. However, the number of lifts in 2022 fell by about 21,000 to about 139,200, largely due to the halt of exports to Russia.

In 2018, the port received a \$25 million BUILD grant to fund expansion projects. That grant money, along with another \$25 million investment from SC Ports, funded the expansion of Inland Port Greer and the lengthening of Norfolk Southern's rail network in the area. The port expansion includes additional rail processing storage tracks, expansion of the container yards and chassis yard, and construction of new facilities for heavy lift maintenance and terminal operations.¹² The Norfolk Southern expansion includes lengthening the lead track outside Inland Port Greer and additional capacity at the track in Carlisle. Together, these changes provide additional capacity and efficiency at Greer.

Economic Development Impacts and Opportunities The inland port employs just under 70 non-union people in the region. The facility has supported the success of nearby businesses, including BMW and Michelin, as well as customers such as Eastman Chemical and John Deere (in Tennessee). The inland port has contributed to new business development in the area, including a

¹² South Carolina Ports, "SC Ports Expanding Inland Port Greer - SC Ports Authority."

Dollar Tree Distribution Center that opened in the late 2010s and Stanley Decker and SK Battery.

The continued demand at Greer could support additional expansion of the facility. However, due to limited land availability, the current expansions exhaust the physical potential of the location. SC Ports may need to look for another site in the next 5 to 10 years to accommodate demand.

6.2 Appalachian Regional Port, Georgia

Background

The Appalachian Regional Port (ARP) is located in Murray County in the northwest of Georgia. The inland port is strategically located to serve a broad region, including parts of Georgia, Alabama, Tennessee, and Kentucky. The inland port provides the region with streamlined access to the global market through its freight rail connection with the deep-water Port of Savannah, 388 miles to the southeast. From the inland port, trucks can reach their final destinations though convenient access to Interstate 75 and US 411.



The inland rail terminal opened in August of 2018 following a roughly \$47 million investment to prepare and construct the facility. The 42acre site facility is owned and operated by the Georgia Ports Authority, in close partnership with Class 1 railroad CSX Transportation, which serves the port. The site features 3 working rail tracks totaling 6,000 feet. The facility has a capacity of 75,000 containers per year, handled by electric lifting equipment.¹³

Operations and Activities

Prior to the construction of ARP, freight was primarily shipped to the region by truck from the Port of Savannah. Now, the connection runs six trains per week (connecting through Atlanta) and each round-trip container movement via rail between ARP and the Port of Savannah

Cambridge Econometrics

¹³ "Georgia Ports Authority. 2023."

offsets 710 truck miles. ARC leads the country in terms of efficiency, technology adoption, and sustainability.

Operations at ARP have increased almost 5-fold since the port opened. In the first year of operation, the port handled about 7,000 lifts. By 2022, that number had grown to 34,000. Even so, the port is operating well below its capacity of 75,000 containers per year and expects to see continued growth in the years to come.

The inland port is located in an industrial belt, which produces and exports carpet, flooring, cars, and tires. Despite the strong manufacturing sector, the port is import-dominant, with imports accounting for more than three-quarters of freight movement.

Economic Development Impacts and Opportunities

The inland port has a small and efficient staff of 14 people from the region. While employment at the port itself is modest, the Appalachian Regional Port is a catalyst for economic activity in the region. Several nearby distribution and logistics centers are supported by the port's activities. CMC Logistics is a freight trucking company that works closely with ARC and is located directly across the street from the port. The facility also leases space to ARC to store empty containers. About a mile and a half down the road, GE operates the Southern Logistic Center. The over 500,000 square foot facility serves as a fulfillment and distribution warehouse for ARC. The \$32 million center opened in March 2020.¹⁴ There is additional industrially-zoned land near the inland port which ARP expects will be developed over time, providing a broader logistics and manufacturing eco-system in northwest Georgia.



6.3 Marathon Refinery, Kentucky

Background

Marathon Petroleum Corporation operates a large refinery in Catlettsburg, a small city in the northeast corner of Kentucky. The refinery sits on more than 650 acres and is located at the confluence

¹⁴ Treinen, "GE Appliances' Southern Logistics Center in Georgia Named Supply & Demand Chain Executive's 2021 Top Supply Chain Project."

of the Big Sandy and Ohio Rivers. Marathon also owns facilities in surrounding riverfront areas in Ohio and West Virginia. The Marathon facility is part of the Port of Huntington Tri-State, one of the largest inland ports in the US by tonnage.

Both the Big Sandy and the Ohio River are navigable (the Big Sandy is dredged by the US Army Corps of Engineers) and serve as a critical inland waterway for the refinery's products that are shipped along the Ohio River to markets in Cincinnati, Louisville and beyond. There are also two Tier 1 railroads, CSX and Norfolk Southern, that provide rail service to hubs across the country. Raw petroleum is generally brought into the refinery via these railways. The Catlettsburg Refinery



Source: Catlettsburg Refinery Fact Sheet, 2021. https://www.marathonpetroleum.com/Operations/Refining/ Catlettsburg-Refinerv/

is also connected to a network of pipelines and highways.

The refinery is centrally located within an eight-hour truck drive of 50 percent of the US population and 60 percent of the country's manufacturing base. By air, products from the refinery can reach 80 percent of the US population within two hours. The facility also lies halfway between Chicago and the Port of Virginia. From Catlettsburg, both of these major freight hubs can be reached by rail in about 12 hours.

Operations and Activities

The Catlettsburg Refinery processes both sweet and sour crude oils, which are usually shipped to the refinery via rail. The facility refines these inputs into usable products, such as gasoline, distillates, asphalt, aromatics, heavy fuel oil, and propane.¹⁵ Jet fuels constitute a large share of the refinery's output; the facility produces about 1 million gallons of Jet A fuel per day. In total, the Catlettsburg facility has a total crude oil refining capacity of 291,000 barrels per calendar day. Marathon's major customers include the Cincinnati airport (CVG), supporting its air freight operations via DHL and Amazon. Marathon's products are also shipped via the Ohio River to the UPS

¹⁵ "Catlettsburg Refinery | Marathon Petroleum Refineries."

air cargo facility in Louisville. These products are shipped via barge and then the 'last mile' connections are made from riverports to the airport facilities.

Economic Development Impacts and Opportunities

The Marathon facility is central to the region's economy. Marathon is one of the largest employers in the northeast Kentucky area, second only behind health care. Marathon employs about 760 people at the Catlettsburg Refinery and over 1,500 employees in the region.

In addition to its regular employees, the refinery also provides thousands of contract jobs to support its maintenance and facility updates. Each year, the refinery spends hundreds of millions of dollars (sometimes over \$1 billion) on facility updates during scheduled outages. In 2015, the facility completed construction of a condensate splitter which increased the refinery's capacity to process condensate from the nearby Utica shale region.¹⁶ The refinery also supports a host of supply chain activities in the area and collaborates with local institutions for workforce development, including welding and other technical programs.

6.4 SEDA-COG Joint Rail Authority, Pennsylvania

Background

bund The SEDA Council of Governments (SEDA-COG) is an economic development consortium of 11 counties in central Pennsylvania, all of



which overlap with the Appalachian Region. In 1983, following several large railroad consolidations and bankruptcies, SEDA-COG Joint Rail Authority (JRA) was created as a municipal authority with the mission to "preserve and foster rail service in Central Pennsylvania and to further economic development through retention, improvement and expansion of the infrastructure and the rail service it supports."¹⁷

JRA exclusively supports and helps operate bulk short-line railroads, with no intermodal traffic, and aims to provide competitive freight

¹⁶ "Catlettsburg Refinery | Marathon Petroleum Refineries."

¹⁷ "SEDA-COG Joint Rail Authority – Preserving Rail Service in Central Pennsylvania."

rail service for the region's industrial businesses. JRA also helps maintain and operate a handful of small transloading facilities allowing freight to move between truck and rail.

Given its public funding structure and stated purpose of preserving freight rail transport, in some cases, JRA continues to operate unprofitable lines. By continuing service on these tracks, JRA ensures that rail is available for future economic development opportunities. As fuel costs rise and traffic congestion worsens, freight movement via rail is increasingly attractive for businesses in the area, and is generally more environmentally-friendly per ton shipped or received.

Today, JRA owns six rail lines, totaling about 220 miles of track. JRA is responsible for capital improvement projects, which are typically funded through JRA revenue streams and federal and state grants. The cost of capital investments varies year to year depending on need and grant funding availability. Between 2017 and 2023, average annual capital investments totaled \$4 million. In 2022 and 2023 (anticipated), capital investments averaged about \$6 million.

Operations and Activities

Rail services are provided through a strategic partnership with North Shore Railroad Company, which serves as the rail operator. JRA also coordinates with Norfolk Southern whose rail lines also interchange with the JRA in



the region. Key commodities moved by JRA and its short-line railroads include:

- Grain Mill Products
- Food Products
- Chemicals
- Lumber and Wood Products
- Iron and Steel Scrap
- Motor Vehicle Parts
- Nonmetallic Minerals and Products
- Petroleum Products

Coal used to be the key commodity moved by JRA. However, declining demand for the fossil fuel reduced coal trains to two or

three unit trains per year. Additionally, Norfolk Southern uses JRA trackage rights to deliver a small number of coal unit trains to a local power plant, though that plant will convert to natural gas by 2025.

Most freight moved by JRA is bulk inbound shipments to manufacturers. Output from these manufacturing facilities is primarily moved by truck to its final destination. Manufacturing has historically been and continues to be an important industry in the region, largely due to rail infrastructure and workforce. The JRA's rail infrastructure is critical and supports the manufacturing industrial base in central Pennsylvania.

In 2022, JRA moved over 21,000 carloads of freight. While this represents a large increase from the first year of operation's 670 carloads, it is down from the peak of the Marcellus Shale boom in 2010 and 2011, when the rail moved over 30,000 carloads.

Economic Development Impacts and Opportunities The six JRA railroads provide competitive freight rail service to over 100 customers in central Pennsylvania. These customers, in turn employ about 12,600 people, supporting the robust and diverse manufacturing industry in the region.

As discussed above, maintaining railroad use in the area is a priority for the JRA. By continuing operations during periods when many private rail companies were shutting down, JRA kept the rail industry in central Pennsylvania alive. Now, the railroad provides crucial freight movement in the region, supports the area's manufacturing sector, and keeps opportunities open for continued growth in the future.

6.5 Chattanooga Metropolitan Airport, Tennessee

Background

The Chattanooga Metropolitan Airport (CHA) is a small hub airport approximately five miles from downtown Chattanooga. The Metropolitan Airport Authority took over ownership of the facility in 1985 and continues to oversee operations. The airport has experienced significant growth over the past two decades, coinciding with the revitalization of Chattanooga and the growth of the regional economy.

The 950-acre site features two runways, a passenger terminal concourse, parking amenities, air cargo facilities, and



aircraft rescue and firefighting services. General aviation facilities provide hangar storage, maintenance, aircraft parking and tie-down options, and an executive terminal building.¹⁸ In 2018, the airport supported almost 60,000 flights serving over 1 million passengers.

Runway 2-20 is the primary runway used for commercial flights at CHA. The 7,400-foot runway is intersected by the airport's second runway, Runway 15-33. Runway 15-33 is smaller (5,575 feet) and mostly used for general aviation operations.

Operations and Activities

Commercial flights account for the vast majority of aviation activity at the airport. These flights from CHA provide passengers with direct connections to hubs including Charlotte, Dallas, and Chicago. Commercial carriers include Allegiant, Delta, American Airlines, and United. The number of people traveling through CHA more than doubled between 2003 and 2018, from 237,000 enplaned passengers to over 504,000.¹⁹ In 2019, the airport reached an all-time high of 554,000 passengers before travel was disrupted during the Covid-19 pandemic in 2020. CHA recovered to 432,000 enplaned passengers in 2022.²⁰

To accommodate the upward trend in passengers, CHA is expanding. The airport is adding 36,000 square feet, including a 26,000 square foot terminal expansion. The \$28 million terminal project includes three new passenger gates with jet bridges and an additional TSA check point space. There will also be new concessions and additional restrooms, as well as a 2,570 square-foot restaurant that will seat 70 in the dining area and 24 at the bar area. A four-level parking garage was also completed recently, during the Covid-19 pandemic. The \$23 million facility was primarily funded through loans. The airport also receives a fee from rental car companies that operate in the garage.

Based on 2018 data, there are about 100 general aviation aircrafts based at the airport. More than three-quarter of these are parked in corporate hangars. Hangar occupancy is near capacity and the airport frequently received requests from prospective tenants.²¹ The airport anticipates needing an additional 20 hangar spaces by 2037.

¹⁸ InterVISTAS, "Chattanooga Metropolitan Airport Master Plan."

¹⁹ InterVISTAS

²⁰ Pare, "Chattanooga Airport Boardings Surge in 2022 but Lag Pre-Pandemic High | Chattanooga Times Free Press."

²¹ InterVISTAS, "Chattanooga Metropolitan Airport Master Plan."

Cargo aviation accounts for a smaller portion of the airport's operations. The airport's cargo apron has two aircraft parking positions which are served from a 12,000 square foot facility operated by FedEx. FedEx has a Boeing 757 based at CHA with a capacity of about 57,000 pounds. FedEx operates one cargo flight in and out of Memphis per day. Ad-hoc cargo charters also operate out of CHA, mostly carrying auto parts for Volkswagen. Freight loads through CHA generally operate at below-capacity, so expansion of this aviation activity is not anticipated in the near term.



Economic Development Impacts and Opportunities

The airport supports jobs, tourism, and freight movement in the Greater Chattanooga area. The airport employs about 1,500 people and this number will likely increase as CHA expands. Continued growth at the airport led to the terminal expansion project, which in turn will provide more economic opportunities for the region. Similarly, the growth of regional businesses like Volkswagen have helped drive the demand for air connections and increased flight operations.

In addition to commercial airline travel, general aviation is an important component of the airport's activities. There is sufficient demand to support additional general aviation hangar spaces at CHA, which currently operates at capacity. However, the airport is restricted by capacity constraints. In the future, technology improvements that reduce runway size requirements could help free up some additional space for hangar spaces or other activities.

CHA is an industry leader in terms of environmental sustainability. The campus includes at 2.1-megawatt solar farm, which links back to the local power grid. The electricity produced at the farm offsets almost all the electricity used at the airport facility. The solar farm helped the airport achieve Leadership in Energy and Environmental Design (LEED) Platinum certification for the West Side Corporate Aviation Development. The three-phase solar project was launched in 2011, expanded in 2013, and completed in 2019. The solar farm was funded through a Federal Aviation Administration (FAA) Voluntary Airport Low Emission (VALE) Grant.

6.6 Lessons learned

The success stories of these five freight logistics facilities demonstrate the importance of:

- **Partnerships**, especially with Class 1 railroads for rail-related facilities. Besides the Chattanooga Airport, each of the freight facilities established a relationship with nearby Class 1 railroads. Inland Port Greer and the Appalachian Region Port directly partner with Norfolk Southern and CSX, which serve the ports and provide important connections to major seaports. The Marathon Refinery and JRA also coordinate with Norfolk Southern and CSX to move products to freight hubs. These partnerships allow the facilities to efficiently reach the global market and, in many cases, share costs of expansion and capital improvement.
- **Supporting the local economy**. Successful freight facilities identify and fill a need in the local economy. In the case of Inland Port Greer, the BMW facility and other local manufacturers needed a way to efficiently transport products to global freight hubs. In central Pennsylvania, there was a need to preserve railroads for future economic development opportunities. By identifying and filling the needs of the local economy, these facilities were able to capitalize on unmet demand for freight logistics and help provide critical infrastructure for business.
- Leveraging existing assets and infrastructure. The five freight facilities effectively utilize existing assets and infrastructure to meet their needs. The Marathon Refinery takes advantage of its access to navigable waterways, such as the Ohio River, to cost-effectively ship bulk products. The Greer and Appalachian Regional inland ports capitalize on existing infrastructure at highways and major seaports to connect local manufacturers to the rest of the world. The Chattanooga Airport uses a portion of its large site as a solar farm, which offsets the electricity used at the facility. Leveraging these assets reduces costs and enhances efficiency at the freight facilities.
- Expanding economic development impact. Through their operations, these facilities contribute to local economic development. The sites provide jobs to the local workforce, generate land use opportunities, support new business development, and strengthen the manufacturing sector. Developing strong local and regional partnerships reinforces the role of freight in the local economy and helps expand regional economic impacts.

7 Summary of Findings and Potential Next Steps

7.1 Findings from the freight analysis

Freight remains a pillar of the Appalachian Region's economy and has provided strong job growth over the past twenty years. Appalachia has a robust network of freight facilities, including highways, aviation, rail, and navigable inland waterways. The freight industry is continually evolving and faces several significant changes. Recent years have seen a demand shift away from coal, which has historically been an important commodity in the Region. Increased population and demand for same-day delivery has prompted investment in transportation and warehouse logistics technology and last-mile connections. Freight carriers in the Region and around the country face a shortage of truck drivers as well as adequate truck parking. In planning for the future, the industry is focusing on sustainability and climate change resilience in freight and investing in technology to support autonomous vehicles and drone delivery.

This report provides an updated assessment of freight flows and trends in Appalachia. The analysis employs novel methodology to estimate freight flows and commodity shipments to, from, and within Appalachia. Key findings of this **freight flow analysis** include:

- About 730 million tons of freight worth about \$990 billion was shipped inbound to Appalachia in 2019. Overall, the Appalachian Region had a slight net inflow of goods (about 6 million more tons and \$66 billion more value imported into the region than was shipped outbound). A substantially smaller amount of freight moved within Appalachia (600 million tons worth about \$380 billion), and these shipments tended to be relatively heavy bulk goods with lower value per ton whereas freight moving into or out of the Region was worth more per ton.
- Gravel and coal are the largest freight commodities in the Appalachian Region in terms of weight (290 million tons of gravel and 258 million tons of coal in 2019). Appalachia's top commodities in terms of value are an entirely different set of goods, led by motorized vehicles (\$242 billion) and mixed freight (\$215 billion).

This assessment also considered **four subregions of Appalachia** to better understand geographic variations in freight shipments.

- The North subregion of Appalachia had the most freight flows, both in terms of tonnage (about 690 million tons) and value (about \$800 billion) and had a net inflow of goods. The other regions generally had a net outflow of goods or an approximately equal balance of inbound and outbound shipments.
- The top commodities in terms of tonnage were gravel and coal for each of the subregions except the South, where gravel and

logs were the largest commodities. Coal accounted for a particularly large share of freight tonnage in the North Central subregion. In terms of value, motorized vehicles, mixed freight, and pharmaceuticals were the largest commodities across most subregions. In the North Central region, machinery was also a significant commodity group.

Employment in freight industries (i.e., rail transportation, truck transportation, warehousing & storage, and water transportation) is another important component of Appalachia's freight network covered in this report.

- About 270,000 Appalachians were employed in freight industries in 2021, led by the truck transportation and warehousing and storage sectors.
- In total, freight transportation jobs accounted for about 3.2 percent of the Appalachian Region's total employment. Despite this relatively modest share of overall employment, Appalachia has a relatively high concentration of freight jobs (location quotient of 1.15).
- Employment in freight industries has grown faster than overall employment in Appalachia and the rest of the country. This result is driven by the warehousing and storage sector, which saw employment triple between 2001 and 2021.

A **subregional assessment of employment** in Appalachia demonstrated the following key takeaways:

- North and South subregions had the most freight employment in 2021, each accounting for about a third of the total freight employment in the Region. Pennsylvania accounted for over three quarters of the employment in the North subregion, whereas employment in the South subregion was more evenly spread amongst states.
- In 2021, about 24 percent of the Region's freight employment came from the South Central and a substantially smaller share came from the North Central region (about 8 percent).

Lastly, five freight facilities in Appalachia were identified and reviewed as case studies, revealing the importance of partnering with freight carriers, supporting the local economy, and leveraging existing assets and infrastructure.

7.2 Potential Next Steps

This 2023 report for the ARC and Network Appalachia provides an important update on Appalachia's freight transportation infrastructure, freight flows by mode, and the employment contribution of freight sectors. Moving forward, we've outlined a few potential next steps.

Stakeholder outreach and identifying freight investment

priorities. As in the case of the 2009 "Network Appalachia: Access to Global Opportunity" study, this report of freight, trade, and economic

development in Appalachia can spur coordination and discussion among regional leaders and stakeholders. To initiate these discussions, ARC could distribute this report through a mix of briefings and other communication, inviting stakeholders to follow up and provide feedback throughout the process. One focus of these discussions and communications may be how ARC can partner with other groups to support freight and trade initiatives throughout Appalachia.

The detailed information provided in this report can also be leveraged to identify freight investment and policy priorities for Appalachia. Briefings of the report to key stakeholder groups could facilitate input from regional leadership and focused discussions on priorities for the Region. Convening regional leaders to discuss Appalachian freight priorities may be helpful to coordinate potential investments and plan for future changes in the freight industry. These discussions may warrant a follow-on study to further explore some of the topics presented in this report or develop updated priorities.

Potential purchase of Transearch commodity flow data for Appalachia. The freight flow estimates in this report utilize publicly available sources to approximate commodity movement in the Appalachian Region and subregions. For more precise measures, Transearch data could be used. Transearch provides detailed historical and projected freight flow data at the county level. The data capture through-traffic and route freight flows to highway and rail corridors, providing a more complete analysis of regional flows.

Purchasing county-level Transearch data would cost \$75,000 for base year (2021) data on the 423 counties in the Region.²² Historical data for the previous five years would cost an additional \$25,000. Transearch also offers aggregated data for a discounted cost. Base year data aggregated for the entire Appalachian Region would cost \$10,000, plus an additional \$2,000 for each historical or forecasted year up to 10 years in either direction. Data more than 10 years away from the base year would cost \$1,000 per year. Transearch data could also be aggregated for a subregional analysis. Base year data at the subregion level (for four subregions) would cost about \$25,000 and additional historical or forecasted data within 10 years of the base year would cost \$2,000 each. Additional data more than 10 years away from the base year would cost \$1,000 per year.

²² Transearch cost estimates are based on CE communication with Paul Ciannavei, Associate Director at S&P Global Market Intelligence.

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