NORTH CAROLINA
STATEWIDE MULTIMODAL FREIGHT PLAN

Planning for the Future of Freight Movement

COMMODITY FLOW ANALYSIS - DRAFT

North Carolina Statewide Multimodal Freight Plan

Commodity Flow Profile

Prepared for:
North Carolina Department of Transportation

Prepared by:
HNTB Corporation
343 E Six Forks Rd #200
Raleigh, NC 27609

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ACRONYMS

B2B	Business-to-Business
B2C	Business-to-Consumer
BIL	Bipartisan Infrastructure Law
BLS	Bureau of Labor Statistics
BTS	Bureau of Transportation Statistics
CMA	Census Metropolitan Area
FAF	Freight Analysis Framework
FAF5/ FAF5.2	Freight Analysis Framework, version 5.2
FHWA	Federal Highway Administration
FIPS	Federal information Processing Standard
BLS	Bureau of Labor Statistics
BTS	Bureau of Transportation Statistics
Mfg.	Manufactured
Min.	Mineral
Misc.	Miscellaneous
MS Access	Microsoft Access
MSA	Metropolitan Statistical Area
NAICS	North American Industry Classification System
NCPFN	North Carolina Priority Freight Network
OD	Origin-Destination
SMFP	North Carolina Statewide Multimodal Freight Plan
Prods.	Products
SCTG	Standard Classification of Transported Goods
SE	Southeast
SW	Southwest
UAVs	Unmanned Aerial Vehicles
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

North Carolina's freight system's needs are driven by existing and future freight demand. The North Carolina Statewide Multimodal Freight Plan (SMFP) presents existing (2017) and potential future (2050) demand for freight in the state and compares the data to the previous SMFP which used existing (2012) and future (2045) planning horizon year data. Commodity flow analysis is central to the development of the SMFP. Commodity flows for 2017 and 2050 informed network designation, modal profiles, supply chain analyses, and economic contribution estimates conducted throughout development of the plan. The report also provides insight into modal dependence, route choice, and equipment and service needs of the state's businesses.

Although the SMFP was not designed to foresee the level of change due to a global pandemic, the planning process it introduces is even more relevant as a result of COVID-19. The unpredictable disruption of a pandemic and other more traditional drivers of change are altering the way people value mobility and make transportation choices, forcing transportation agencies to adapt operations, management, and investment in the transportation system. All data in this report is pre-COVID except for the freight generators data in Section 2.0.

1.1 Data and Methodology

Several data sources were used in the commodity flow analysis as follows:

- Freight Analysis Framework version 5.2 (FAF5.2) Database**.** The Freight Analysis Framework (FAF), produced through a partnership between the Bureau of Transportation Statistics (BTS) and the Federal Highway Administration (FHWA), integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas by all modes of transportation. Starting with data from the 2017 Commodity Flow Survey (CFS) and international trade data from the Census Bureau, FAF incorporates data from agriculture, extraction, utility, construction, service and other sectors. FAF5.2 provides estimates for tonnage and value by regions (multi-county or state FAF zones) of origin and destination (OD), a 2-digit Standard Classification of Transported Goods (SCTG) commodity type and mode. Data are available for the base year of 2017, with annual estimates for 2018, 2019, 2020, 2022 and 2023, as well as 5-year increment forecasts from 2025 through 2050. FAF5.2 2017-2050 data were disaggregated by mode to obtain truck, water, air, pipeline and other modal flows at the county level for North Carolina. Appendix A describes the FAF5.2 methodology. Data from 2017 (pre-COVID data) were used from FAF5.2 therefore numbers were not adjusted for COVID. FAF data values are in constant dollars and include long-term inflation from 2017 to 2050. FAF5.2 was the current data set available in January 2022 when the data analysis started. FAF5.3 was released in April 2022 after completion of the data analysis.

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- Bureau of Transportation Statistics (BTS) TranStats Database**.** T-100 United States Market data provide annual air cargo statistics for all North Carolina airports with reported activity. The data contain domestic and international market data reported by United States and foreign air carriers and contains market data by carrier and origin-destination (OD) for enplaned freight and mail. Data from 2019 (pre-COVID data) were used from BTS therefore numbers were not adjusted for the COVID pandemic.

- Data Axle, formerly known as Infogroup or InfoUSA, is a private firm that provides annual employment and industry data since 1972**.** The data contain employment by location, fleet size and primary and secondary industry information for each business in North Carolina. Data from 2021 were used from Data Axle to show the most recent numbers of freight generators in North Carolina. Numbers were not adjusted for the COVID pandemic because the data represented freight generating business and not freight flows. Pre-COVID data not affected by the pandemic was used for commodity flows while 2021 data was used for freight generators as freight operations were found to be impacted by COVID but the freight generating businesses would remain relatively the same. The number of companies producing freight generators was not assumed to change.

1.2 Report Organization

This profile consists of five chapters. Chapter 1, this introduction, is followed by four additional chapters:

- **Freight Generators** (Chapter 2) illustrates the location, employment size and fleet size of freight generating industries in North Carolina.
- **FAF5.2 Zone Level Freight Demand** (Chapter 3) examines North Carolina's actual and projected freight activity at the FAF5.2 zone level, including what are the top zones generating freight tonnage and value.
- **North Carolina's Trading Partners** (Chapter 4) identifies the state's top domestic and international trading partners for freight imports and exports.
- **Statewide Freight Demand** (Chapter 5) provides an overview of actual and projected demand for freight transportation in North Carolina, including modal split, directional analysis and top commodities moving in the state.

2.0 FREIGHT GENERATORS

A freight generator is any business that produces a commercial good which is transported in the process of being consumed by the public. The generators are of interest to the SMFP due to the demand they place on the priority freight network in North Carolina. The freight generating companies in North Carolina that produce, store and ship freight have varying employment sizes and fleet sizes by location. The analysis herein uses the Data Axle resource which only includes highway fleet vehicles; thus, fleets associated with other modes (such as rail) are not included.

2.1 Freight Employment Size by Location

There are over 316,000 freight generating businesses in the state involving highway fleet vehicles. Table 2.1 shows the employment size of those businesses by location and the number of businesses in the state.

TABLE 2.1 EMPLOYMENT SIZE OF FREIGHT GENERATORS BY LOCATION IN NORTH CAROLINA

Freight Employment Size per Location	Number of Businesses
>5,000 employees	14
2,500-4,999 employees	31
1,000-2,499 employees	109
500-999 employees	227
250-499 employees	619
1-249 employees	315,041
Total	**316,041**

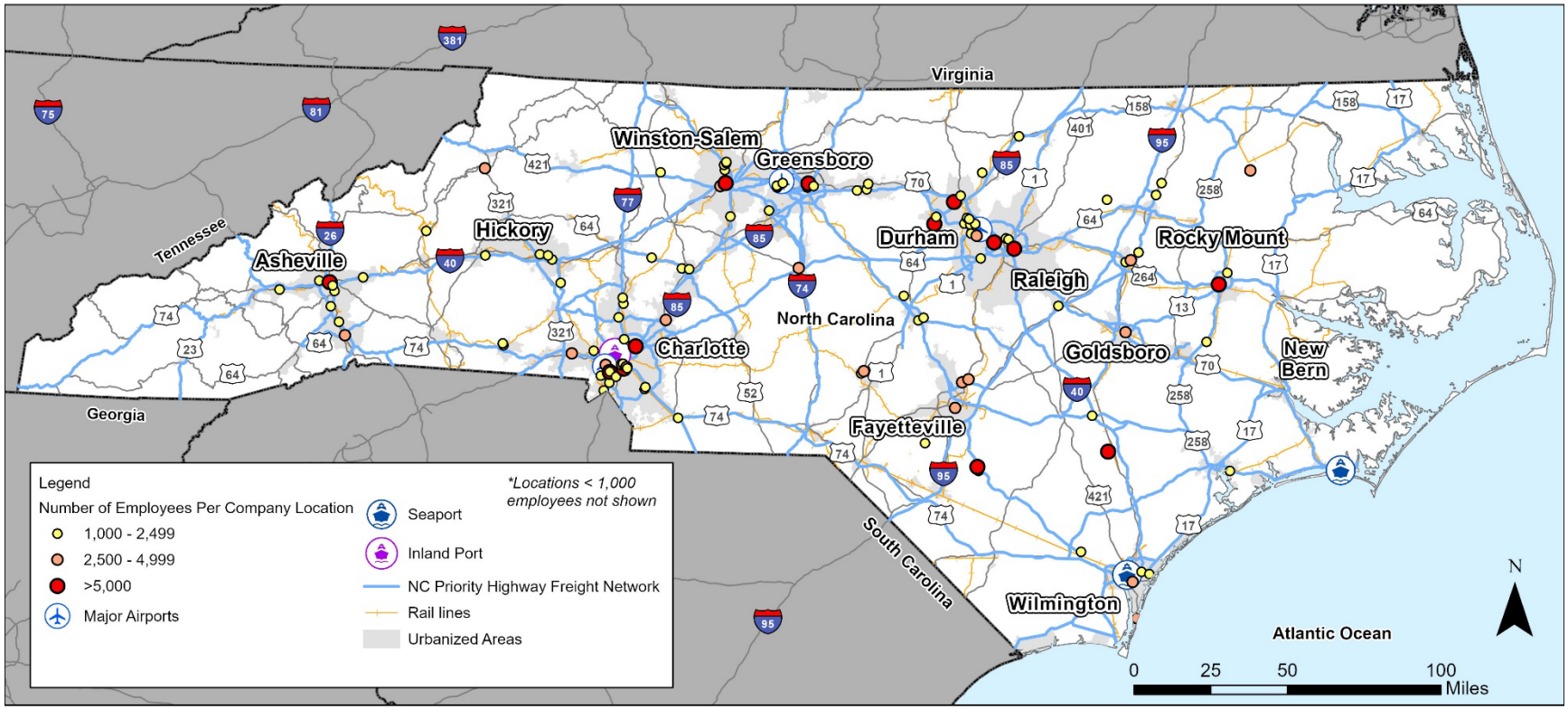
Source: Data Axle, 2021

Figure 2.1 illustrates where the business locations with 1,000 employees or more are located in North Carolina. Business locations with under 1,000 employees are not shown in the figure. There is a pattern of businesses aligning with the population density so that most small businesses are concentrated along the Piedmont corridor from Raleigh to Charlotte. Many of the businesses with over 2,500 employees at one location are in the urbanized areas of Asheville, Winston-Salem, Greensboro, Charlotte, Durham and Raleigh. There are fourteen locations with over 5,000 employees in North Carolina. Freight generating businesses with less than 250 employees represent 99% of all freight generating businesses in the state.

Locations with between 1,000 – 2,499 employees also tend to be located in or near urbanized areas with only a small share of businesses in these categories being located in more rural areas of the state.

Most business locations with over 1,000 employees (Figure 2.1) are located along or within proximity to the North Carolina Priority Highway Freight Network (NCPHFN). This shows strong connectivity to businesses around the state via the designated freight network to allow highway freight to travel to, from and within North Carolina.

FIGURE 2.1 EMPLOYMENT SIZE OF FREIGHT GENERATORS BY LOCATION IN NORTH CAROLINA



Source: Data Axle, 2021

2.2 Freight Occupations and Employment

Trucking is the dominant freight mode in North Carolina. In 2017, trucks moved 86% of freight by weight and 83% of freight by value to, from and within North Carolina. The truck driving occupation and associated vehicles used can be broken out into different categories. Table 2.2 lists the types of truck occupations in the state and the definitions of those occupations.

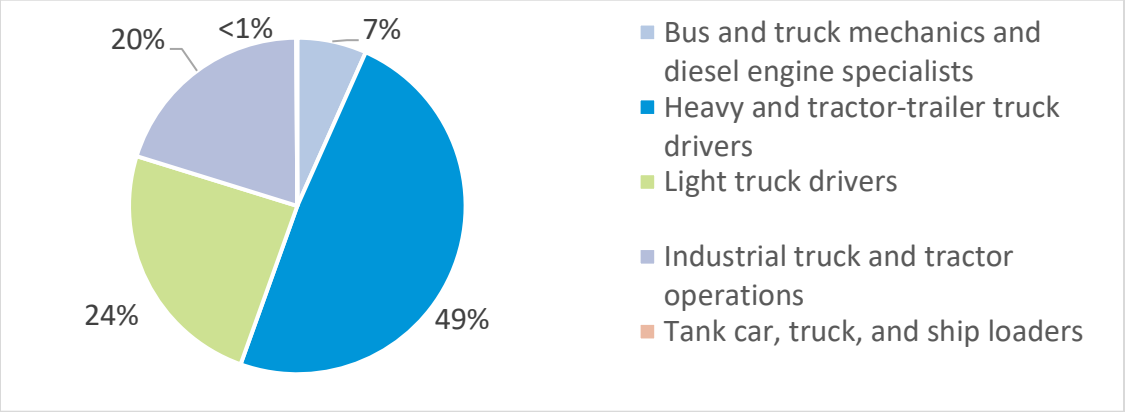
TABLE 2.1 TRUCK DRIVING OCCUPATIONS DEFINITIONS

Truck Driving Occupations	Definition[1]
Bus and Truck Mechanics and Diesel Engine Specialists	"Diagnose, adjust, repair, or overhaul buses and trucks, or maintain and repair any type of diesel engines. Includes mechanics working primarily with automobile or marine diesel engines."
Heavy and Tractor-Trailer Truck Drivers	"Drive a tractor-trailer combination or a truck with a capacity of at least 26,001 pounds Gross Vehicle Weight (GVW). May be required to unload truck. Requires commercial drivers' license. Includes tow truck drivers. Excludes "Refuse and Recyclable Material Collectors"."
Light Truck Drivers	"Drive a light vehicle, such as a truck or van, with a capacity of less than 26,001 pounds Gross Vehicle Weight (GVW), primarily to pick up merchandise or packages from a distribution center and deliver. May load and unload vehicle. Excludes "Couriers and Messengers" and "Driver/Sales Workers"."
Industrial Truck and Tractor Operations	"Operate industrial trucks or tractors equipped to move materials around a warehouse, storage yard, factory, construction site, or similar location. Excludes "Logging Equipment Operators"."
Tank Car, Truck, and Ship Loaders	"Load and unload chemicals and bulk solids, such as coal, sand, and grain, into or from tank cars, trucks, or ships, using material moving equipment. May perform a variety of other tasks relating to shipment of products. May gauge or sample shipping tanks and test them for leaks."

Source: Bureau of Labor Statistics (BLS), 2021.

Figure 2.2 shows the percentages of truck drivers per occupation. There are nearly 137,000 truck drivers employed in North Carolina.

FIGURE 2.2 TRUCK DRIVING OCCUPATIONS EMPLOYMENT PERCENTAGES



Source: Bureau of Labor Statistics (BLS), 2021.

[1] Bureau of Labor Statistics (BLS), 2021. Available at: https://www.bls.gov/oes/current/oes_nc.htm#53-0000

As shown in Figure 2.2, heavy and tractor-trailer truck drivers make up 49% (66,830 jobs) of truck driving jobs in North Carolina followed by light truck drivers at 24% (33,290 jobs). This shows that most of the freight moved by truck in the state is hauled by heavy and tractor-trailer truck drivers and light truck drivers.

Table 2.3 lists the number of private and commercial vehicles in North Carolina. There are nearly 8.5 million registered private and commercial vehicles.

TABLE 2.2 PRIVATE AND COMMERCIAL VEHICLE TOTALS BY TYPE

Private and Commercial Vehicles by Type[2]	Number of Vehicles	Percent of Private and Commercial Vehicles
Automobiles	3,352,960	40%
Buses	11,233	<1%
Trucks	5,042,146	60%
Total	**8,406,339**	**100%**

Source: Federal Highway Administration (FHWA), 2020.

Trucks account for 60% of registered private and commercial vehicles in North Carolina. The number of truck driver employees compared to the number of total registered trucks in North Carolina differ due to companies potentially registering trucks in other states for tax purposes for regional and national fleets. The truck driver shortage in the United States also plays a role.

2.3 Industry Categories

Freight-generating industries were categorized in the state to analyze where commercial goods and products were in North Carolina. The data were divided into industry categories using the North American Industry Classification System (NAICS) which categorizes industries by primary line of business. These categories were then grouped into categories by industry type, as shown:

- Agriculture / forest / fish
- Mining, quarrying and oil and gas extraction
- Construction
- Manufacturing
- Transportation/ utilities/ warehousing
- Wholesale trade
- Retail trade
- Finance/ insurance/ real estate
- Service/ public administration

The percent of establishments in each industry category can be seen in Figure 2.3. The service and public administration industry accounts for 47% of the businesses in the state. These businesses include offices, hotels,

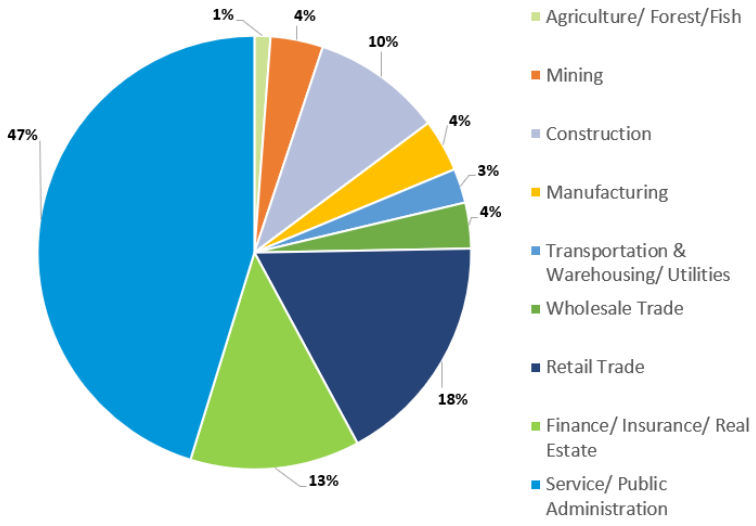
[2] FHWA Office of Highway Policy Information, 2022. Available at: https://www.fhwa.dot.gov/policyinformation/statistics/2020/mv1.cfm

lodgings and health services. Freight products for this industry include finished goods such as office and other supplies, food, linens, pharmaceuticals and medical devices, and other consumer goods. These businesses play a key role in the movement of vehicles but have a small weight of freight movement associated with them. When looking at the remaining categories, by number of industry locations in the state, the top industries are retail trade (18%), finance/insurance/real estate (13%) and construction (10%). Real estate includes anything moved by real estate offices, agents or brokers.[3] This also includes the movement of goods to and from mini-warehouses and self-storage[4].

The freight industry categories listed above include all industries that transport freight as part of their business. When looking further into these industries, there are freight intensive industries whose business heavily relies on the movement of goods. These freight intensive industries include the following:

- Agriculture / forest / fish
- Mining, quarrying and oil and gas extraction
- Construction
- Manufacturing
- Transportation/ utilities/ warehousing
- Wholesale trade
- Retail trade

FIGURE 2.3 PERCENTAGE OF FREIGHT INDUSTRIES



Source: Data Axle, 2021

[3] NAICS Codes.

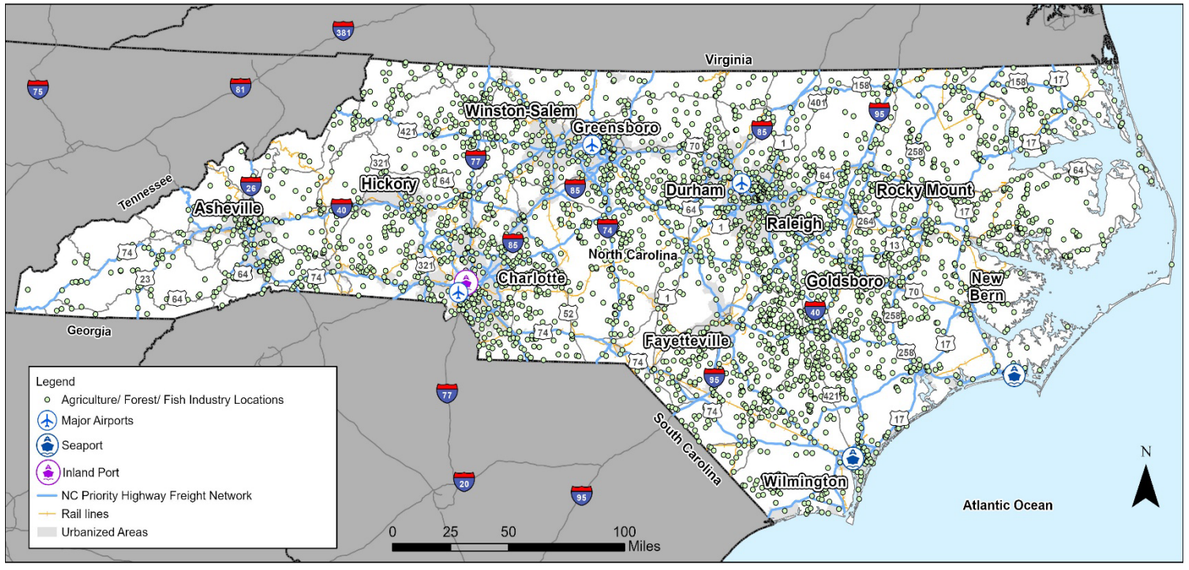
[4] NAICS Codes, Real Estate.

Agriculture / Forest / Fish Industry

Figure 2.4 shows the agriculture / forest / fish industry locations in North Carolina. This industry has locations in each region of the state that range from 1 to 2,500 employees per location and are near the priority freight network highways, rail lines, inland port, seaports and airports. Types of commodities these industries generate include:

- Farm produce,
- Tobacco,
- Cotton,
- Animal products,
- Livestock production,
- Logging,
- Hunting and trapping,
- Soil preparations planting and cultivation, and
- Nursery and tree production.

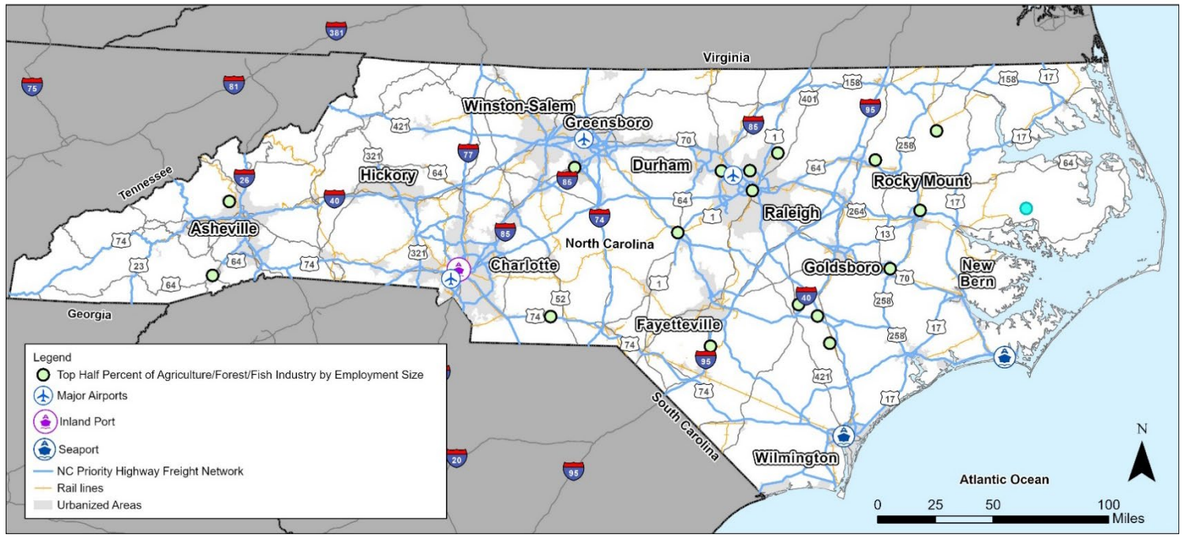
FIGURE 2.4 AGRICULTURE / FOREST / FISH INDUSTRY LOCATIONS



Source: Data Axle, 2021

The agriculture / forest / fish industry has 20 sites in the top 0.5% of industry locations in North Carolina by employment size, shown in Figure 2.5. The number of employees at these locations range from 100 to 2,500. The majority of the top 0.5% of agriculture/forest/fish locations are connected to a NCPFN rail line or highway with two exceptions- one location in southwest North Carolina with 125 employees and one location in eastern North Carolina with 200 employees. There are four agriculture/forest/fish industry locations in the Raleigh area located near Raleigh Durham International Airport as well as one industry location near the Piedmont Triad International Airport in the Winston-Salem-Greensboro area.

FIGURE 2.5 AGRICULTURE / FOREST / FISH INDUSTRY LOCATIONS BY EMPLOYMENT SIZE



Source: Data Axle, 2021

Mining, Quarrying and Oil and Gas Extraction Industry

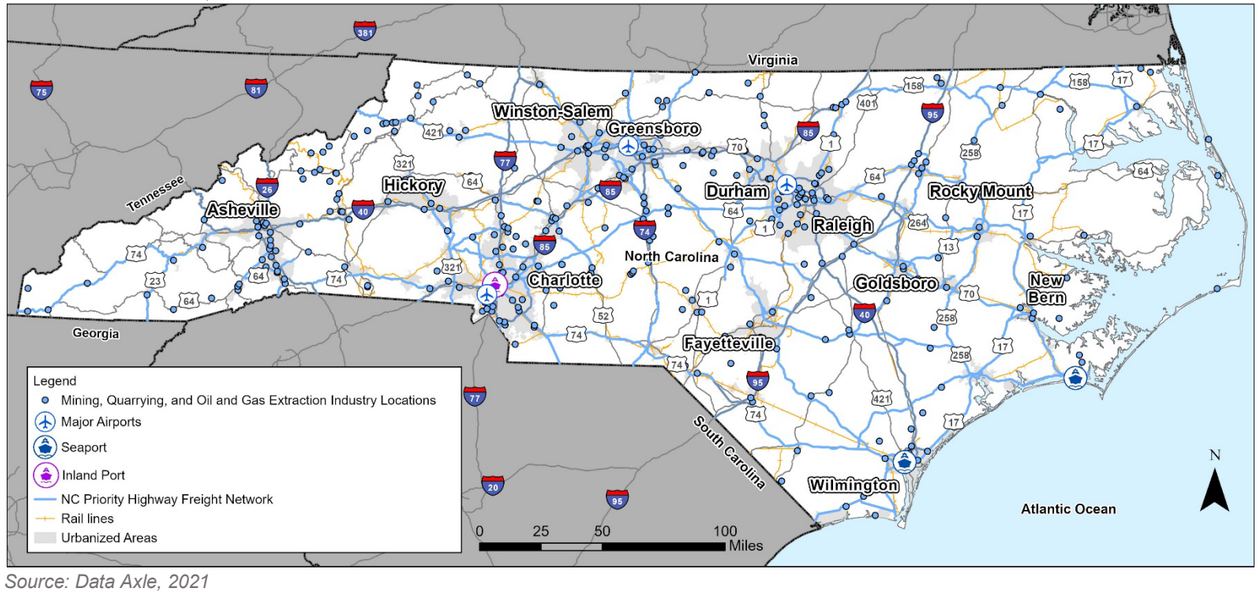
Figure 2.6 shows the 354 mining, quarrying and oil and gas extraction industry locations in North Carolina. These industry locations are located all over the state employing anywhere from 1 to 4,200 employees per location. The majority of mining, quarrying and oil and gas extraction locations in the state are located near a NCPFN highway, rail line, inland port, seaport or airport.

The mountainous terrain in the western part of the state and sometimes remote locations of the facilities lead to many of them not being located on the NCPFN. Types of commodities these industries generate include:

- Crude petroleum extraction,
- Natural gas extraction,
- Bituminous coal and lignite surface mining,
- Anthracite mining,
- Metal ore mining,
- Stone mining and quarrying,
- Sand and gravel mining, and
- Chemical and fertilizer mineral mining.

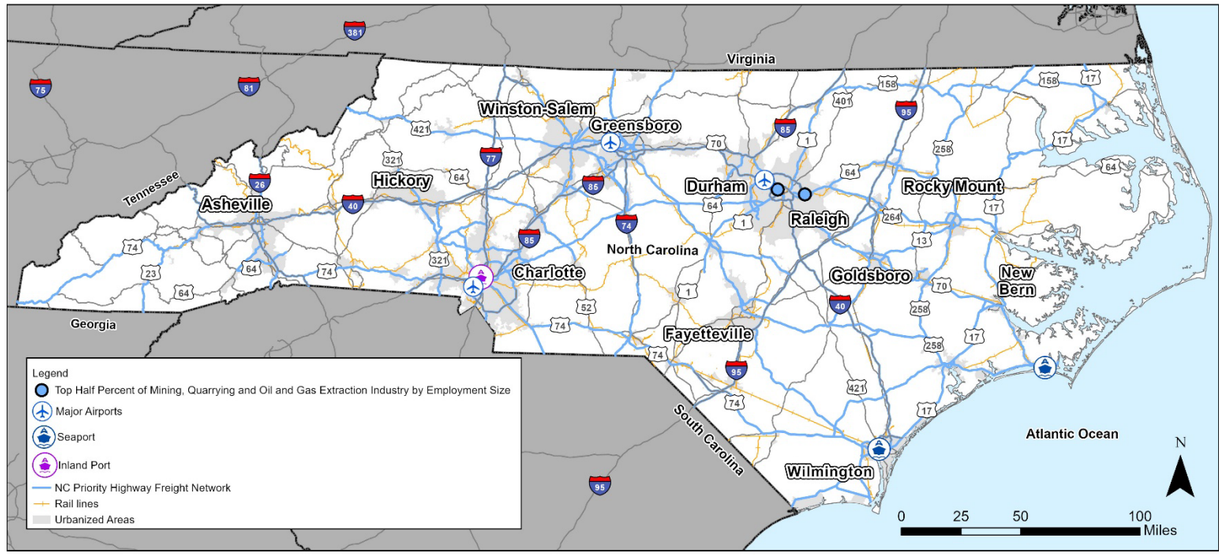
With only 354 locations in the state for mining, quarrying and oil and gas extraction industry facilities, two locations make up the top 0.5% of locations by employment size. These industry locations are shown in Figure 2.7 and are in the Raleigh Durham urbanized area. The number of employees at these locations are 200 and 150, respectively. These two locations are near the Raleigh-Durham International Airport and near freight highways and rail lines that make up the NCPFN.

FIGURE 2.6 MINING, QUARRYING AND OIL AND GAS EXTRACTION INDUSTRY LOCATIONS



Source: Data Axle, 2021

FIGURE 2.7 MINING, QUARRYING AND OIL AND GAS EXTRACTION INDUSTRUY LOCATIONS BY EMPLOYEMENT SIZE



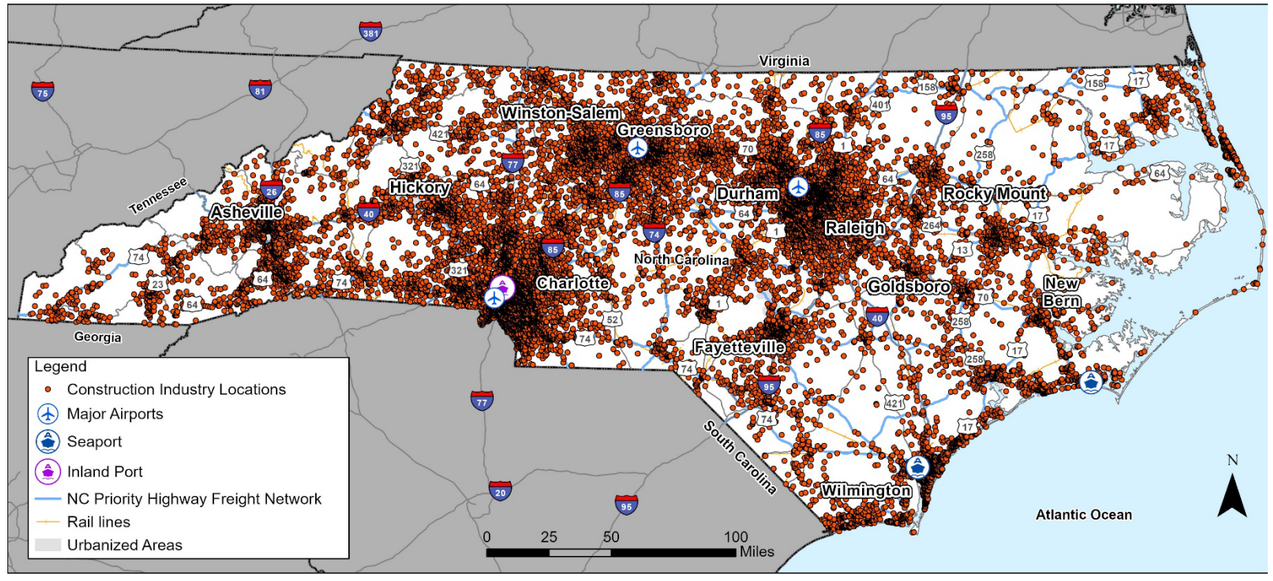
Source: Data Axle, 2021

Construction Industry

Figure 2.8 shows all 31,710 construction industry locations in North Carolina. Construction industry locations are spread all around the state with locations employing between 1 and 10,000 employees at each location. Types of construction commodities these industries generate include:

- Residential housing and remodels,
- Industrial buildings,
- Commercial and institutional buildings,
- Water and sewer line structures,
- Power and communication lines,
- Highway streets and bridges,
- Flooring, carpentry, painting, plumbing, heating, electrical, roofing, masonry, and drywall contractors

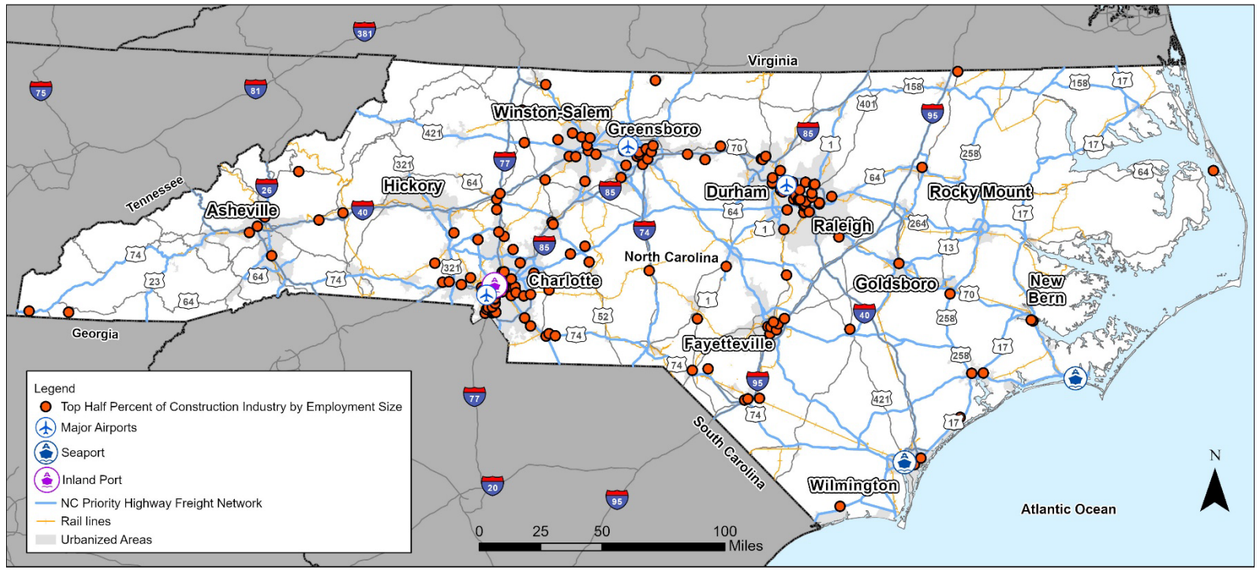
FIGURE 2.8 CONSTRUCTION INDUSTRY BY LOCATION



Source: Data Axle, 2021

The construction industry has 159 locations in the top 0.5% of construction industry locations in North Carolina by employment size, shown in Figure 2.9. The number of employees at these locations range from 100 to 10,000. Many of the construction industry locations are located along I-85 from Charlotte, north to Winston-Salem-Greensboro and east to Raleigh and near the major populations centers with expanding growth.

FIGURE 2.9 CONSTRUCTION INDUSTRY LOCATIONS BY EMPLOYMENT SIZE



Source: Data Axle, 2021

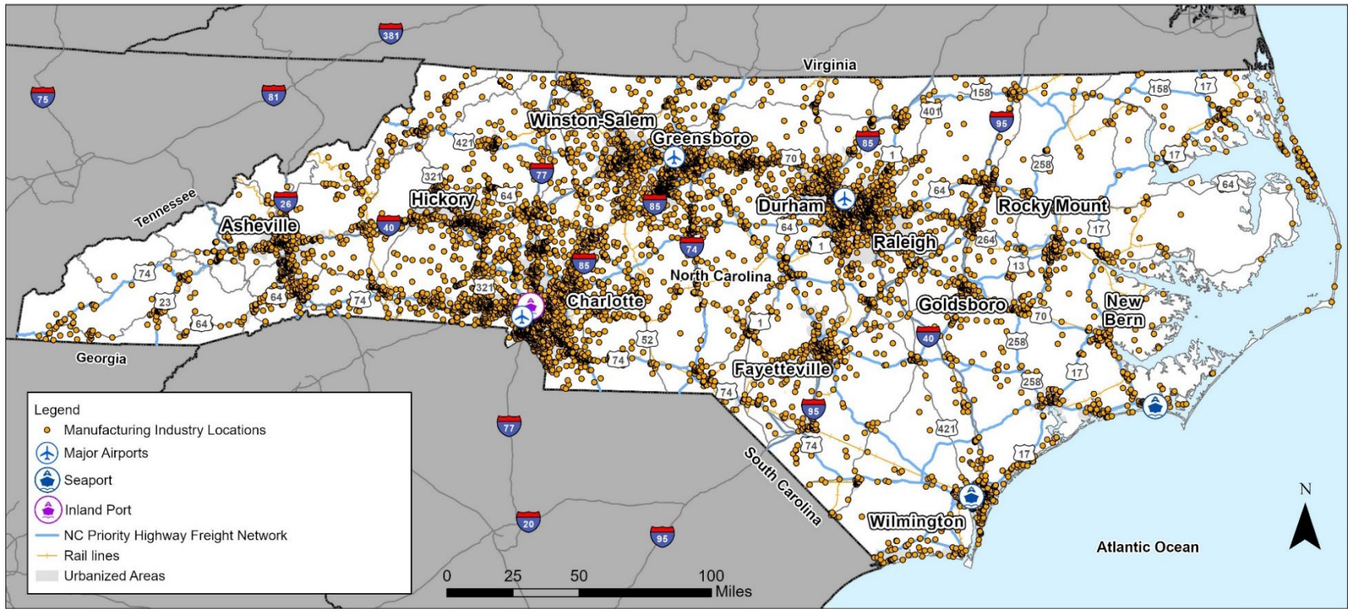
Manufacturing Industry

Figure 2.10 shows the manufacturing industry locations in North Carolina. Manufacturing industry locations are located around the state with high concentrations of locations in the three major urbanized areas of Charlotte, Winston-Salem-Greensboro and Durham. This industry has locations in the state that range from 1 to 8,000 employees per location. Types of manufactured commodities these industries generate include:

- Pet food,
- Flour and corn milling,
- Food and beverage processing and manufacturing,
- Retail and commercial bakeries,
- Textile/textile mills and manufacturing plants,
- Commercial printing,
- Pharmaceutical preparations manufacturing,
- Radio, TV, and audio and video equipment manufacturing, and
- Aircraft and motor vehicles.

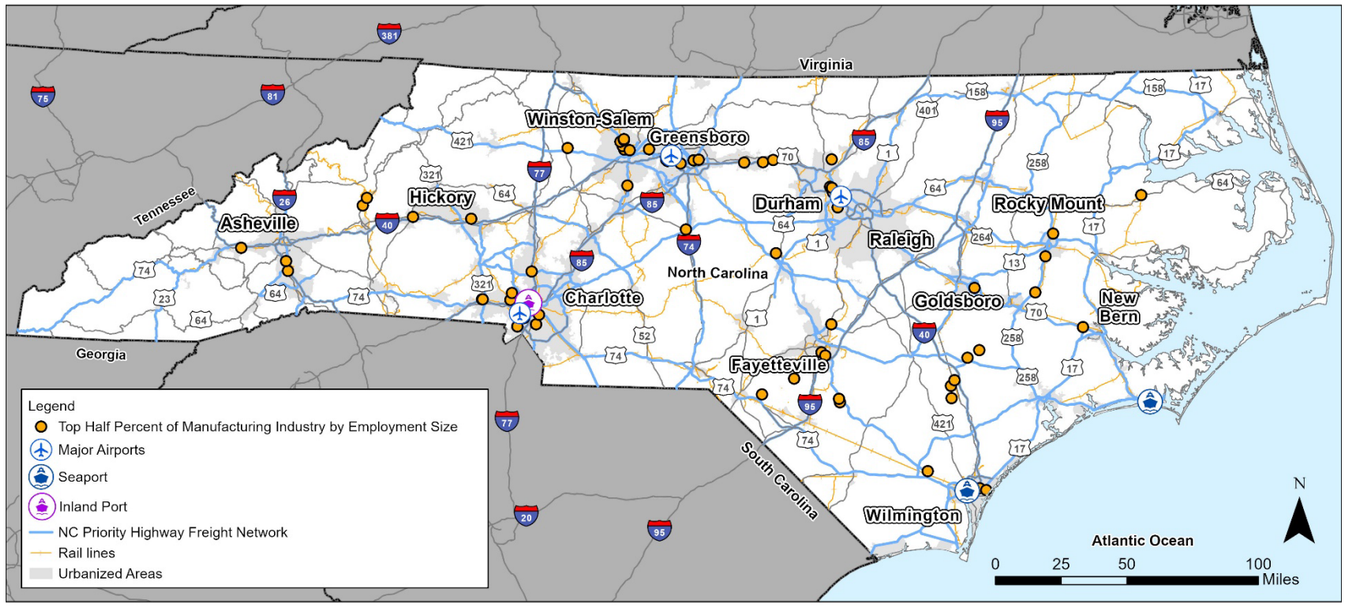
The manufacturing industry has 64 locations in the top 0.5% of industry locations in North Carolina by employment size, shown in Figure 2.11. The number of employees at these locations range from 700 to 8,000. A majority of the manufacturing industry locations are near the highway and rail line portions of the NCPFN. There are also concentrations of manufacturing locations in the urbanized areas of Charlotte, Winston-Salem, Greensboro, Raleigh and Durham near the freight airports and inland port.

FIGURE 2.10 MANUFACTURING INDUSTRY LOCATIONS



Source: Data Axle, 2021

FIGURE 2.11 MANUFACTURING INDUSTRY LOCATIONS BY EMPLOYMENT SIZE



Source: Data Axle, 2021

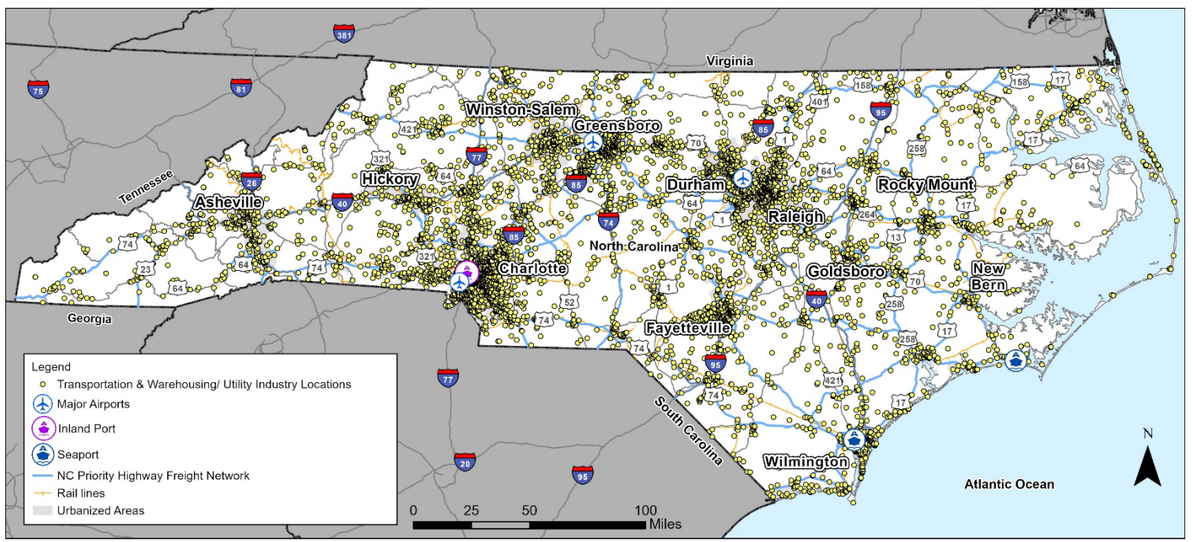
Transportation / Warehousing Industry

Figure 2.12 shows the 8,387 transportation / utilities industry locations in North Carolina. Many of these locations are scattered throughout the state ranging from 1 to 4,800 employees per location. Transportation/ utility industry locations in the state are located throughout the highway, rail, inland port, seaport and airport portions of the NCPFN. Types of commodities these industries generate include:

- Air transportation and airport operations,
- Railroads,
- Deep sea passenger transportation and cargo hauling,
- Inland water freight transportation,
- General and specialized freight trucking,
- Ground transportation (taxi service, limo service, special needs transit),
- Pipeline transportation,
- Farm product transportation, and
- Refrigerated, farm product, and other warehousing and storage.

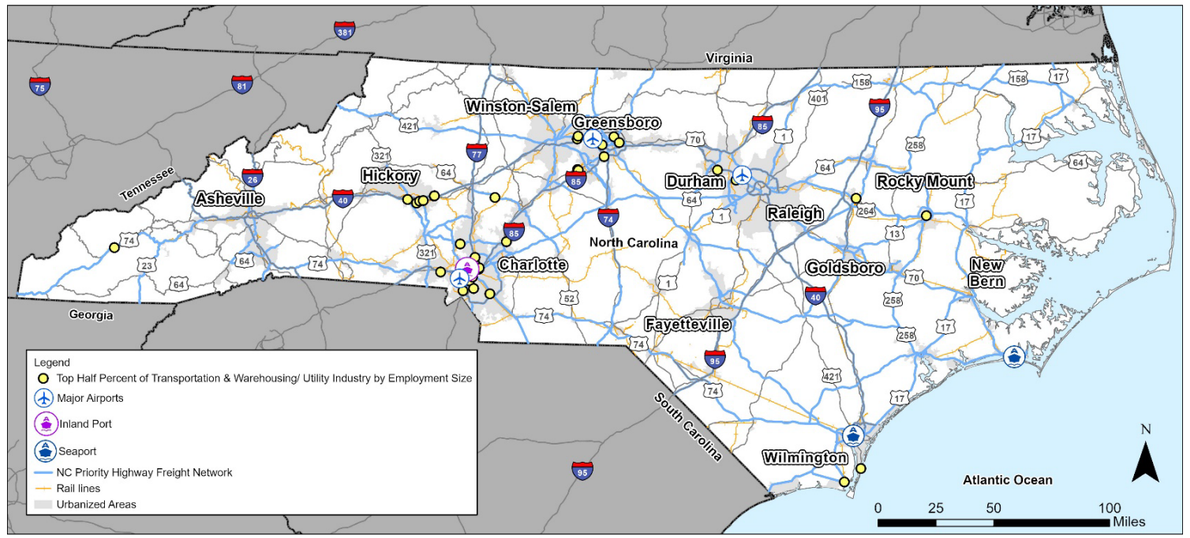
The transportation / utilities industry has 42 locations in the top 0.5% of industry locations in North Carolina by employment size, shown in Figure 2.13. The number of employees at these locations range from 215 to 4,800. This portion of transportation/ utilities industry locations are primarily located in the central region of the state in the urbanized areas of Hickory, Charlotte, Winston-Salem and Greensboro near major airports and rail and highway freight corridors.

FIGURE 2.12 TRANSPORTATION & WAREHOUSING/ UTILITIES INDUSTRY LOCATIONS



Source: Data Axle, 2021

Figure 2.13 Transportation & Warehousing/ Utilities Industry Locations by Employment Size



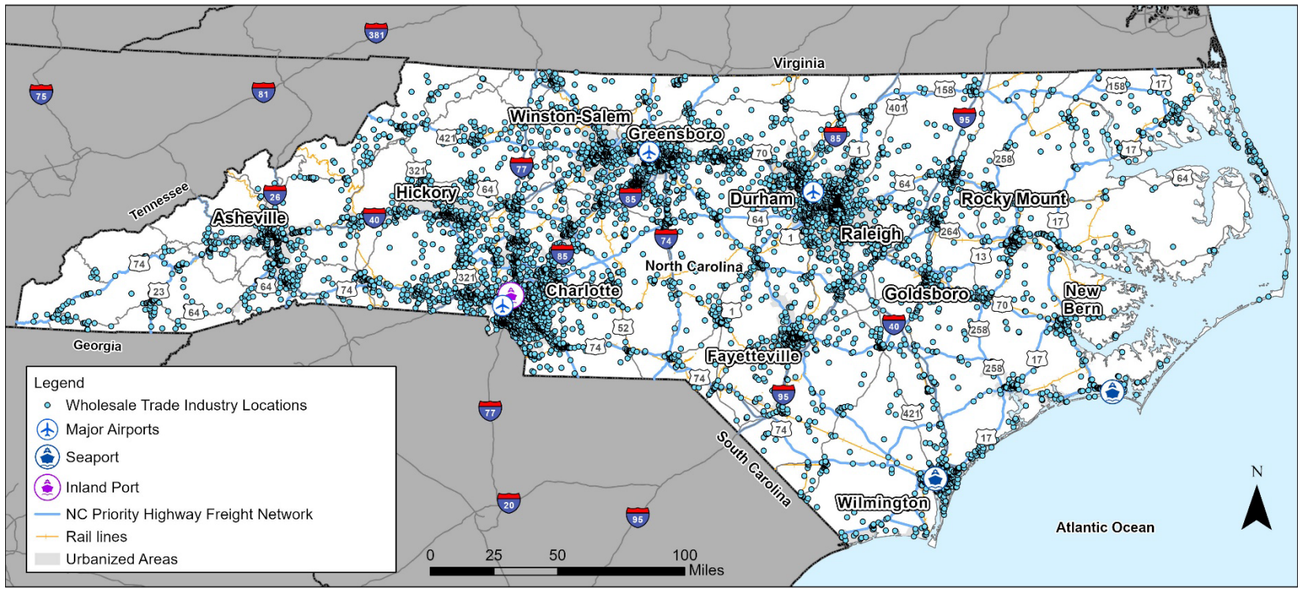
Source: Data Axle, 2021

Wholesale Trade Industry

Figure 2.14 shows the 11,171 wholesale trade industry locations in North Carolina. This industry has locations in the state that range from 1 to 2,300 employees per location. Locations in the state are concentrated in the urbanized areas which contain the NCPFNs highways, rail lines, inland port, seaports and airports. Types of commodities these industries generate include:

- Automotive and other motor vehicle wholesalers,
- Motor vehicle supplies,
- Tire and tube merchant wholesalers,
- Furniture and home furnishing merchant wholesalers,
- Brick, stone, lumber, plywood, millwork/wood panel, roofing, photographic equipment, office equipment, commercial equipment, medical, dental, hospital, farm supplies, and raw materials merchant wholesalers,
- Food and beverage wholesalers,
- Nondurable goods merchant wholesalers, and
- Wholesale trade agents and brokers.

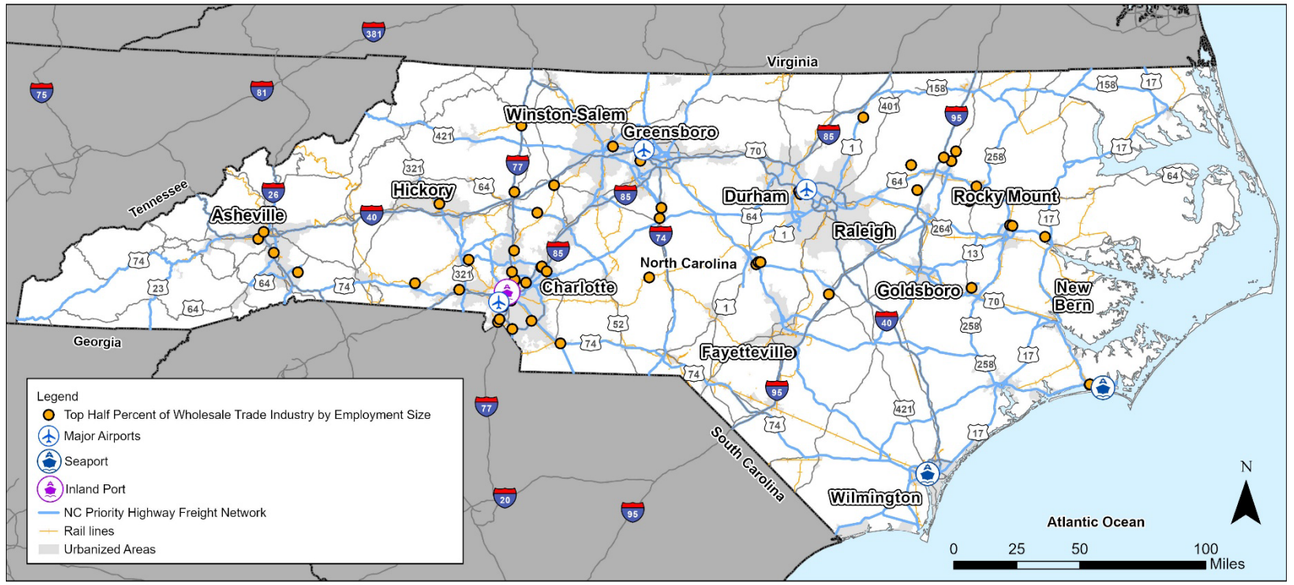
FIGURE 2.14 WHOLESALE TRADE INDUSTRY LOCATIONS



Source: Data Axle, 2021

The wholesale trade industry has 56 locations in the top 0.5% of industry locations in North Carolina by employment size, shown in Figure 2.15. The number of employees at these locations range from 300 to 2,300. Many of the state's wholesale trade industry locations are in proximity to (within less than 25 miles to) interstates, highways and rail lines that makes up the NCPFN.

FIGURE 2.15 WHOLESALE TRADE INDUSTRY LOCATIONS BY EMPLOYMENT SIZE



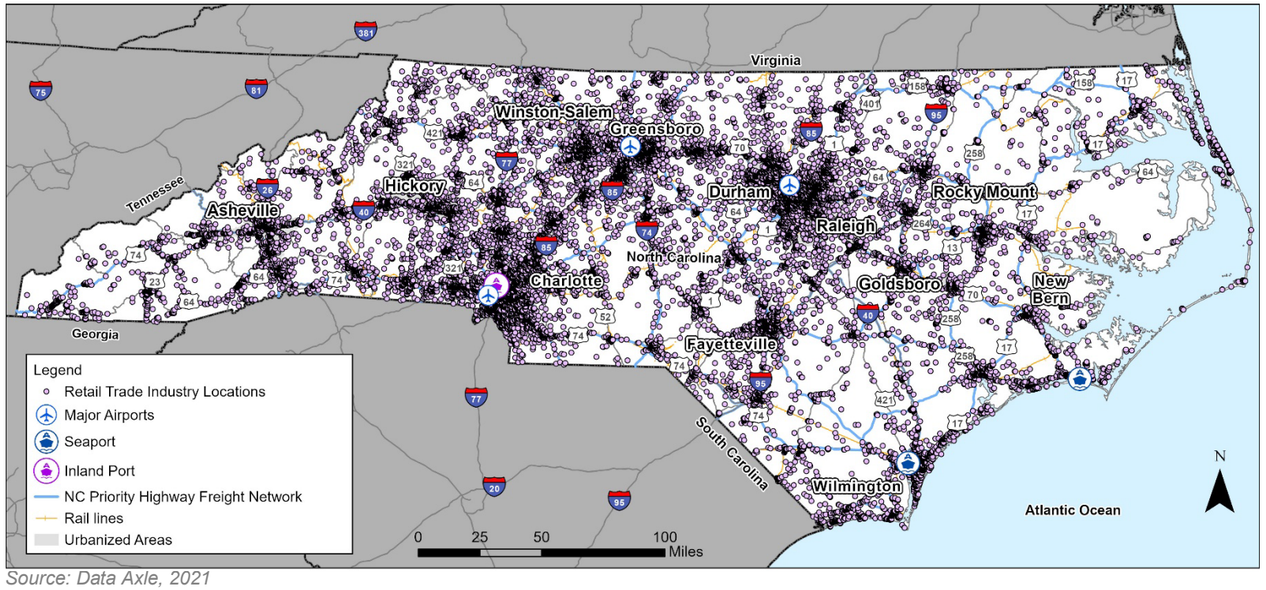
Source: Data Axle, 2021

Retail Trade Industry

Figure 2.16 shows the 56,927 of retail trade industry locations in North Carolina with locations spread throughout the state. Retail trade industry locations in the state that range from 1 to 4,000 employees per location. Types of commodities these industries generate include:

- New car, used car, recreational vehicle and boat dealerships,
- Furniture, household appliances, electronics, home remodeling and stores,
- Nursery, garden center and farm supply stores,
- Supermarkets, grocery stores, markets, and food and beverage stores,
- Clothing stores, florists, department stores, and specialty stores,
- Pet supply stores, and
- Fuel dealers.

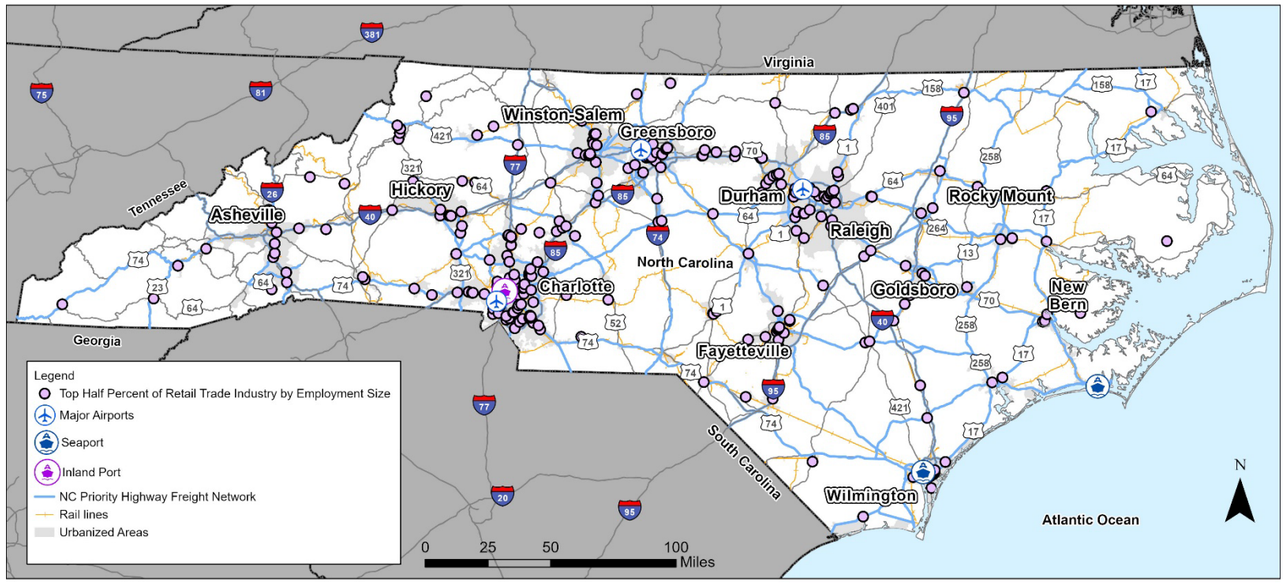
FIGURE 2.16 RETAIL TRADE INDUSTRY LOCATIONS



Source: Data Axle, 2021

The retail trade industry has 285 locations in the top 0.5% of industry locations in North Carolina by employment size, shown in Figure 2.17. The number of employees at these locations range from 200 to 4,000. Many of the industry locations are in the urbanized areas of Charlotte, Winston-Salem, Greensboro, Raleigh and Durham with proximity to highway, rail and airport access.

FIGURE 2.17 RETAIL TRADE INDUSTRY LOCATIONS BY EMPLOYMENT SIZE



Source: Data Axle, 2021

3.0 FREIGHT ANALYSIS FRAMEWORK 5 ZONE LEVEL FREIGHT DEMAND

In 2017, 727 million tons of freight valued at $956 billion moved over North Carolina's transportation system, an increase of 22% from the 594 million tons of freight in 2012. Despite the increase in tonnage, total value of freight on the network declined 4.6% from $1 trillion in value in 2012. By 2050, it is projected that North Carolina's transportation system will need to carry more than 1.14 billion tons of freight annually, valued at $1.86 trillion, an increase of 94% by tonnage and 57% by value. The statewide freight demand is discussed more in section 5 of the Commodity Flow Analysis.

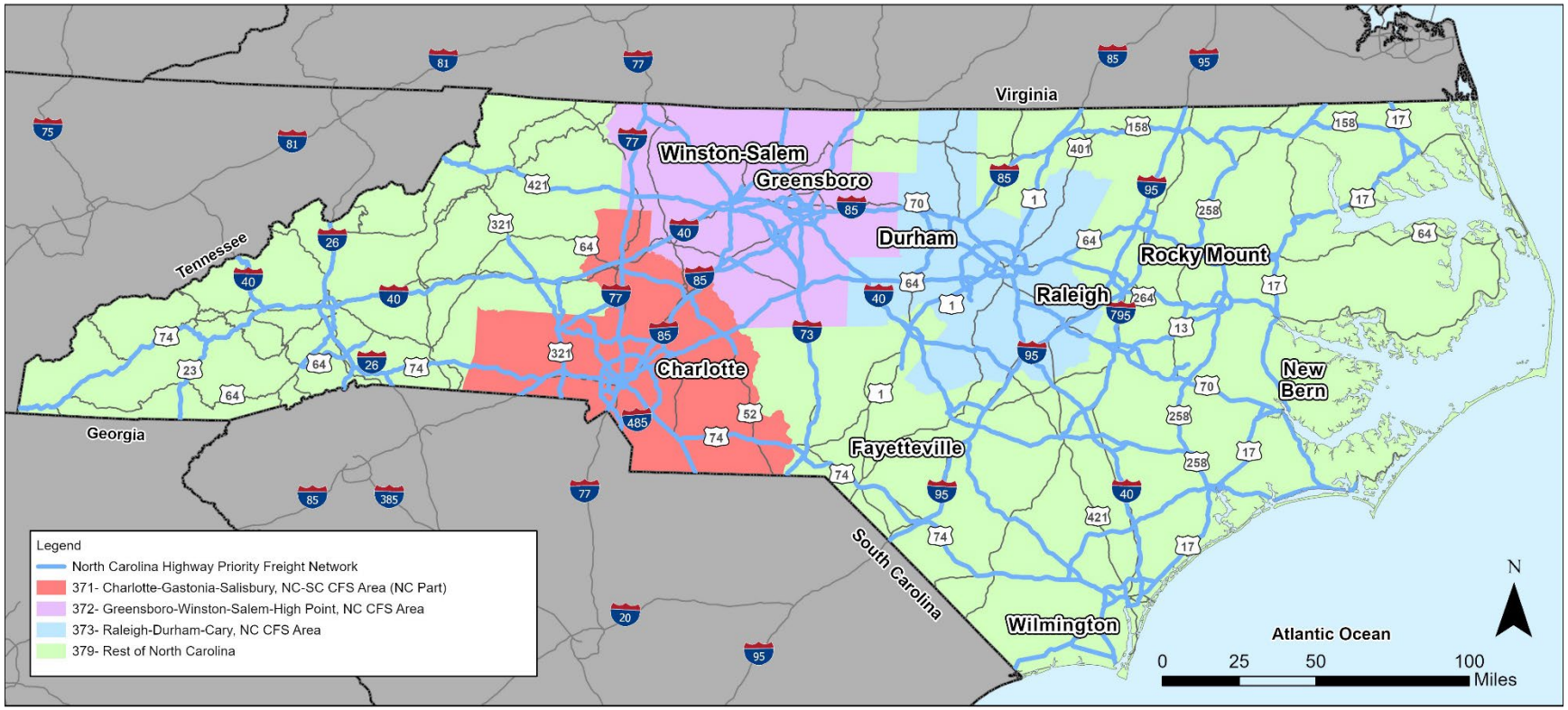
The FAF5.2 data is disaggregated into four zones in North Carolina, as shown in Figure 3.1. In the 2017 SMFP, this freight demand analyzed data at the county level using TranzAct data. FAF5.2 gathers data by FAF5.2 zone and not at the county level. The "Rest of North Carolina" FAF5.2 zone was the dominant goods-movement zone in North Carolina in 2017. This zone can be seen in Figure 3.1 and had a combined imported/exported/intra weight of goods totaling 123 million tons in 2017. This accounted for 48% of the goods moving to, from and within North Carolina. The three additional FAF5.2 zones freight activity measured by weight were:

- "Raleigh-Durham" zone with 62 million tons (24%);
- "Charlotte NC-SC (NC part)" zone with 39 million tons (16%) and;
- "Greensboro-Winston-Salem-High Point" with 29 million tons (12%).

Figure 3.2 and Figure 3.3 show the total tonnage and value of goods that moved within, to or from each North Carolina FAF zone in 2017 and 2050 respectively.

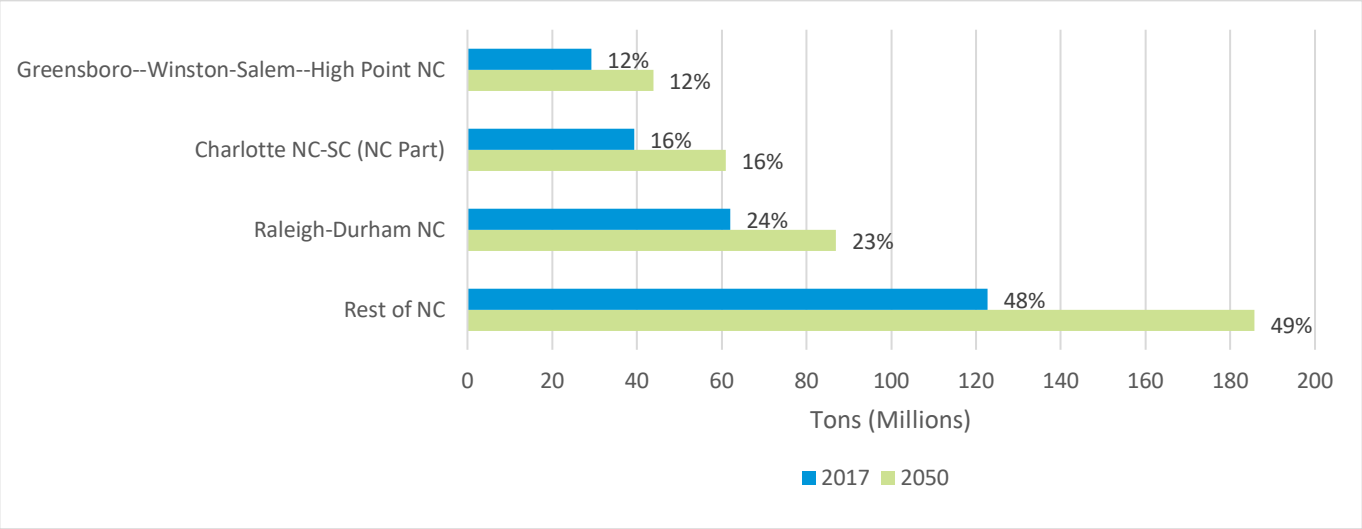
By 2050, the "Rest of North Carolina" is projected to remain the top FAF5.2 zone for the weight of freight activity in the state, projecting to generate 186 million tons (49%) of the total weight shipped to, from and within North Carolina. Out of all North Carolina FAF5.2 zones, the largest percent growth by 2050 is projected for the "Rest of North Carolina" with a 1% overall growth while "Raleigh-Durham" is expected to decrease by 1%. "Charlotte NC-SC (NC part)" and "Greensboro-Winston-Salem-High Point" are expected to increase the total weight moved to, from and within their respective FAF5.2 zones but remain the same percentage of weight moved in the state. All FAF5.2 zones are expected to increase their freight tonnage moved compared to the values moved in 2017. Percentages could decrease while the total value or weight increases due to a FAF5.2 zone not increasing weight or value as fast as other FAF5.2 zones.

FIGURE 3.1 FAF5.2 ZONES IN NORTH CAROLINA



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FIGURE 3.2 NORTH CAROLINA FAF5.2 ZONES BY COMBINED IMPORTED/EXPORTED/INTRA WEIGHT, 2017 AND 2050



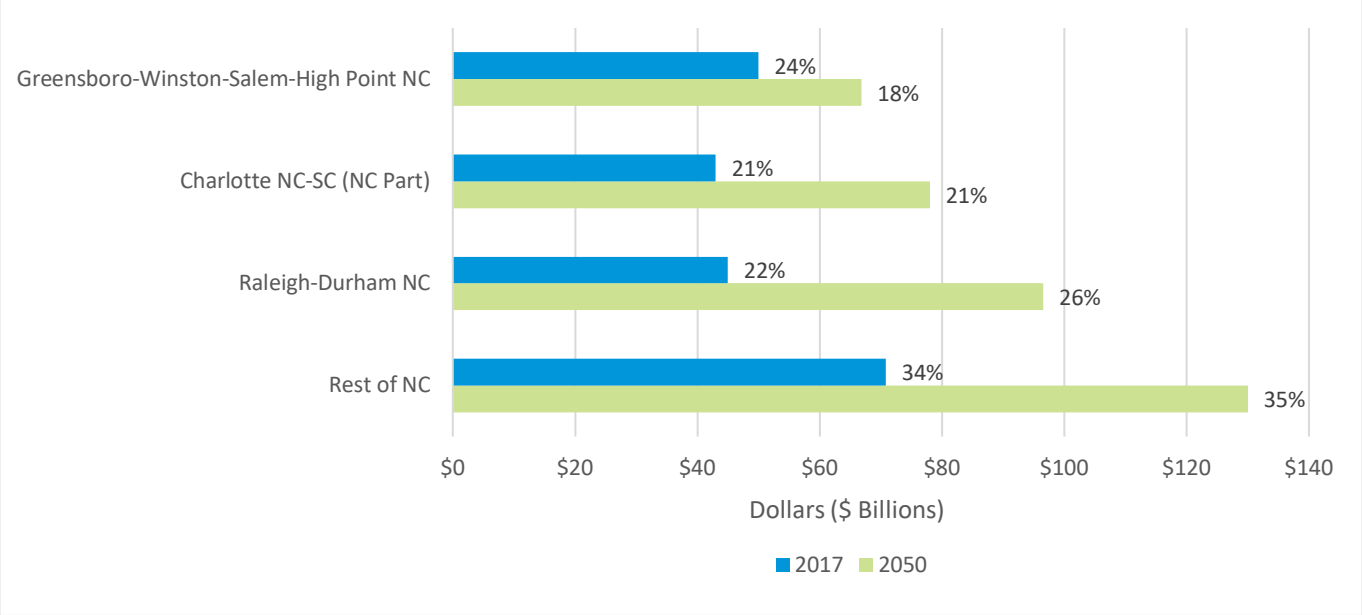
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

Figure 3.3 shows all North Carolina FAF5.2 zones by value in 2017 and 2050 for total imported, exported and intra-county movements.

As shown in Figure 3.3 in 2017, the "Rest of North Carolina" FAF5.2 zone's shipping activity was the highest value of goods in 2017, accounting for 34% of the $208 billion in goods shipped to, from and within North Carolina in 2017. The three additional FAF5.2 zones freight activity measured by value were "Greensboro-Winston-Salem-High Point" with $50 billion tons (24%), "Raleigh-Durham" with $45 billion tons or (22%) and "Charlotte NC-SC (NC Part)" with $43 billion (21%).

In Figure 3.3, by 2050, the "Rest of North Carolina" is projected to remain the top FAF5.2 zone by value of freight activity in the State, projecting to generate $130 billion (35%) of the value of weight shipped to, from and within North Carolina. Out of all North Carolina FAF5.2 zones, the largest percent growth by 2050 is projected to be "Raleigh-Durham" FAF5.2 with an increase in value of 4% compared to 2017. The "Rest of North Carolina" zone is projected to increase by 1% with the "Charlotte NC-SC (NC Part)" projected to remain the same at 21% and "Greensboro-Winston-Salem-High Point" projected to decrease by 6%.

FIGURE 3.3 NORTH CAROLINA FAF5.2 ZONES BY COMBINED IMPORTED/EXPORTED/INTRA VALUE, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

4.0 NORTH CAROLINA'S TRADING PARTNERS

Exports create wealth in a state's economy and the level of exports is one determinate of an economy's growth and vitality. Many of the freight intensive industries and companies with a greater number of employees in North Carolina are located in the densely populated areas of the state and are close to multiple modes of transportation. Freight businesses need to be close to the freight network and populated areas in the state to move goods more effectively.

Domestic shipments include imports and exports through North Carolina ports that are transported to or from destinations within the United States. International shipments include imports and exports through North Carolina ports and ports outside of the state that are transported to or from destinations outside the United States. North Carolina exported more than $34.6 million of freight in 2017 to international and United States locations outside of North Carolina, an increase of 20% from $28.8 million in 2012. Total exported tons in 2017 amounted to 16.1 million tons. Imported goods in 2017 were valued at $46.7 million and weighed 10.3 million tons.

4.1 Domestic Trade Partners

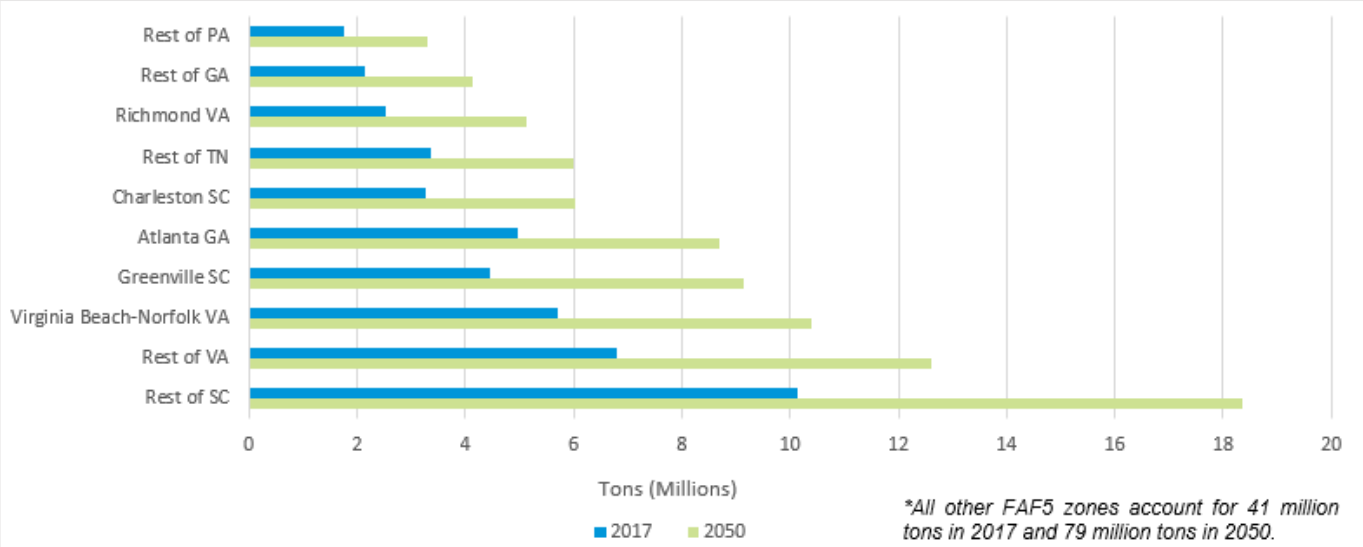
North Carolina Domestic Exports

Goods shipped from North Carolina are transported to a wide range of United States destinations. As shown in Figure 4.1, in 2017, North Carolina sent nearly 474 million tons of goods to destinations throughout the United States, which was a nearly 400% increase from 2012 reported in the previous SMFP completed in 2017. The top domestic destinations for freight[5] were the "Rest of South Carolina"[6] (12% of the outbound tonnage), the "Rest of Virginia" (8%) and "Virginia Beach-Norfolk Virginia" (7%). By 2050, the top three destinations are projected to remain the same. Figure 4.1 shows the top 10 domestic destinations for goods by weight in 2017 and 2050. Figure 5.1 illustrates the FAF5.2 zones in North Carolina while Figure A.1 shows the FAF5.2 zones located in the United States. All other FAF5.2 zones that North Carolina shipped goods to accounted for 41 million tons in 2017 and are predicted to account for 79 million tons in 2050. Commodities exported to these top regions are typically heading to freight gateways such as the Port of Virginia, the Port of Charleston and/or other rail hubs in the surrounding region.

[5] Note: Trade partners are categorized into FAF Zones. FAF Zones were created using the census metropolitan area (CMA) boundaries, such as the Combined Statistical Area (CSA) and Metropolitan Statistical Area (MSA). Many CMA boundaries cross more than one state. Major subareas of a CMA are defined as separate FAF regions, one for each state. Small subareas of a CMA are included with the State or Rest of State regions. A complete description and definition of FAF Zones is available in the FAF5 Users Guide: https://faf.ornl.gov/faf5/data/FAF5%20User%20Guide.pdf

[6] FAF5 zones are available in Figure 4.1 and in a table.

FIGURE 4.1 NORTH CAROLINA TOP DOMESTIC DESTINATIONS BY WEIGHT, 2017 AND 2050

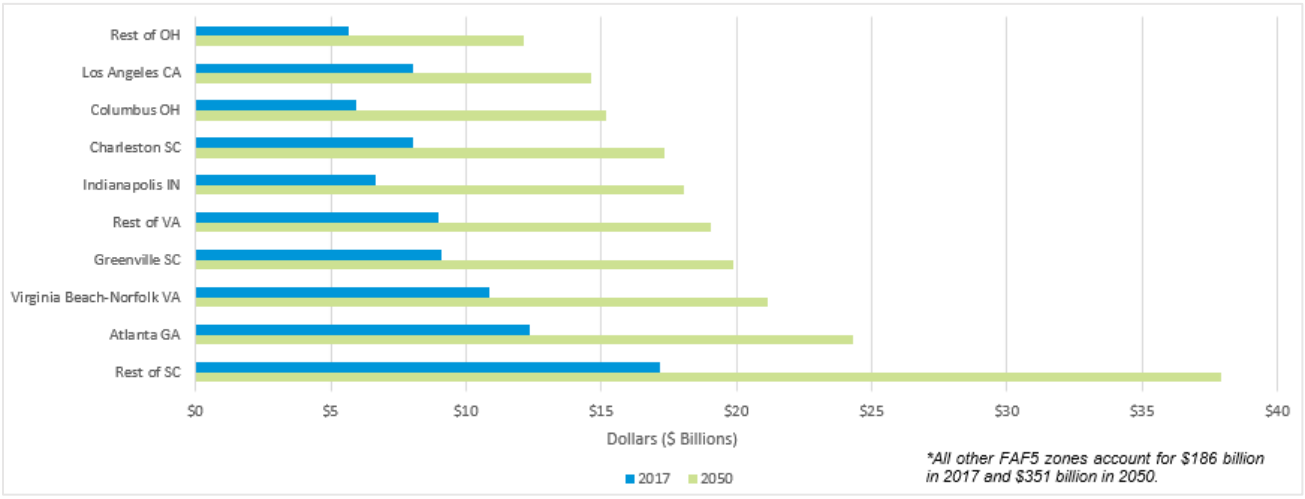


Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

As shown in Figure 4.2, by value, the top 10 trading partners for exported goods in 2017 were dispersed across the country as opposed to when measured by weight where the top destinations were in the Southeast (SE) and Mid-Atlantic regions. North Carolina's top 10 destinations by value shown in Figure 4.2 accounted for $93 billion (33%) of the total exported value in 2017. The top three destinations outside of North Carolina were the "Rest of South Carolina"; "Atlanta"; and "Virginia Beach-Norfolk, VA".

By 2050, the "Rest of South Carolina" is projected to remain the top destination by value outside of North Carolina, joined by "Atlanta, GA"; "Virginia Beach-Norfolk, VA"; and "Greenville, SC". The top 10 destinations in 2050 shown in Figure 4.2 are projected to attract nearly $200 billion or 36% of the total exported value from North Carolina. All other FAF5.2 zones that North Carolina shipped goods to accounted for $186 billion in 2017 and are predicted to account for $351 billion in 2050.

FIGURE 4.2 NORTH CAROLINA TOP DOMESTIC DESTINATIONS BY VALUE, 2017 AND 2050

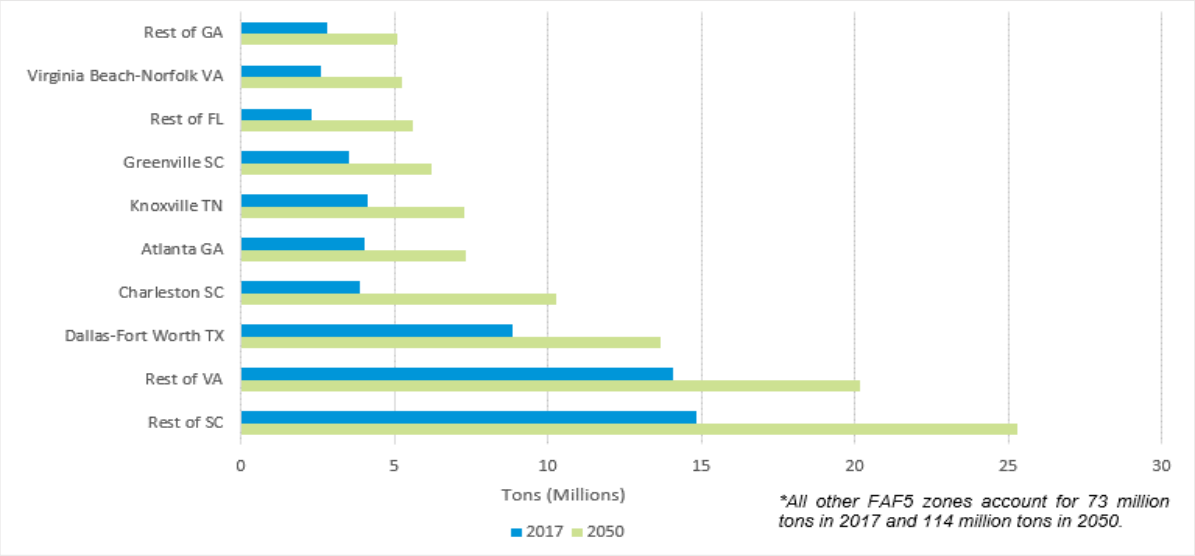


Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

North Carolina Domestic Imports

North Carolina receives goods from trading partners across the country. The top trading partners for imported goods, shown in Figure 4.3, accounted for 45% of the total imported weight in 2017. North Carolina received the most goods by weight from the "Rest of South Carolina", the "Rest of Virginia", and "Dallas-Fort Worth TX-OK (Texas part)". These three origins accounted for 38 million tons (28%) of the total imported tonnage to North Carolina. In 2050, the top three imported goods are projected to remain the same as they did in 2017. Together, the top three projected exported destinations in 2050 are expected to account for 59 million tons and 27% of the imported tonnage in 2050. Figure 4.3 shows the top 10 domestic imported of goods by weight in 2017 and their 2050 projections. All other FAF5.2 zones that North Carolina imported goods from accounted for 73 million tons in 2017 and are predicted to account for 114 million tons in 2050.

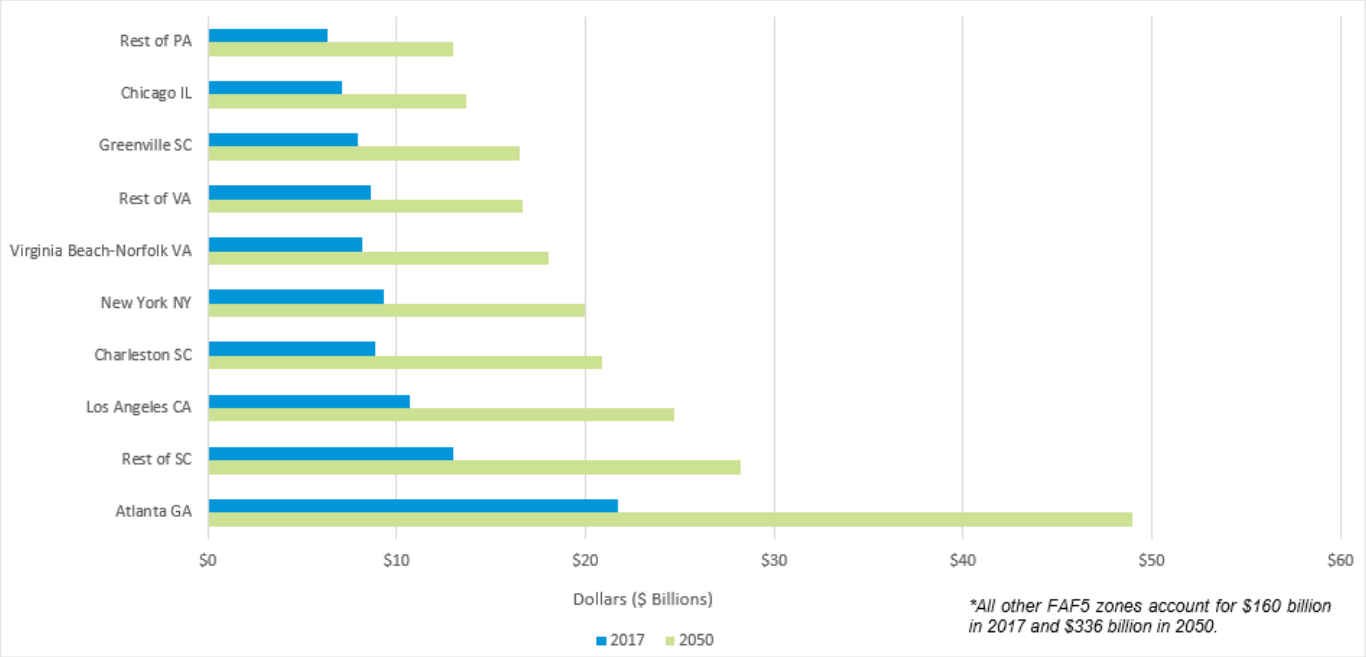
FIGURE 4.3 NORTH CAROLINA TOP DOMESTIC ORIGINS BY WEIGHT, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

By value in 2017, the top domestic origin outside of North Carolina was “Atlanta” followed by the “Rest of South Carolina”, “Los Angeles, CA”, “Charleston, SC”. and “New York, NY”. The top five origins accounted for 24% ($64 billion) of the total value of goods shipped to North Carolina. The remaining top origins in 2017 are shown in Figure 4.4. “New York, NY” and “Philadelphia, PA” are predicted to enter the top 10 domestic origins by value in 2050 while “Chicago, IL” and the “Rest of PA” are predicted to leave the top 10. By 2050, the projected top three will generate 18% of the $102 billion imported goods shipped to North Carolina. Figure 4.4 shows the top domestic imported trading partners for North Carolina and their 2050 projections. All other FAF5.2 zones that North Carolina shipped goods too accounted for $160 billion in 2017 and is predicted to account for $336 billion in 2050.

FIGURE 4.4 NORTH CAROLINA DOMESTIC ORIGINS BY VALUE, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

It is important to note that many of the top ODs by both weight and value are transload hubs. Cities and regions including “Atlanta, GA”, “Los Angeles-Long Beach, CA”, “Chicago-Naperville”, “Virginia Beach-Norfolk”, “Charleston and Savannah” may be the domestic OD, but the ultimate OD of many of the goods that flow through these regions are likely overseas. All these cities and regions were also included in the previous 2017 SMFP.

4.2 International Trade Partners

In 2017, international trade accounted for approximately 26.4 million tons of goods shipped to and from North Carolina worth over $81 billion. In 2012, international trade consisted of 20 million tons worth over $76 billion in the state. In 2017, 61% (up from 58% in 2012) of these foreign shipments were United States imports, and the rest were United States exports. These international shipments include imports and exports through North Carolina ports and ports outside of the state. By 2050, foreign shipments in the state are projected to rise to 69 million tons of goods worth more than $108 billion compared to the projected 55 million tons of goods worth $333 billion in 2045. With the increase in weight and decrease in value of goods, this would mean the projected commodities are expected to be lower value goods.

The international trading partners can be divided into eight regions (as defined by the United Nations Statistics Division[7]):

- “Canada”

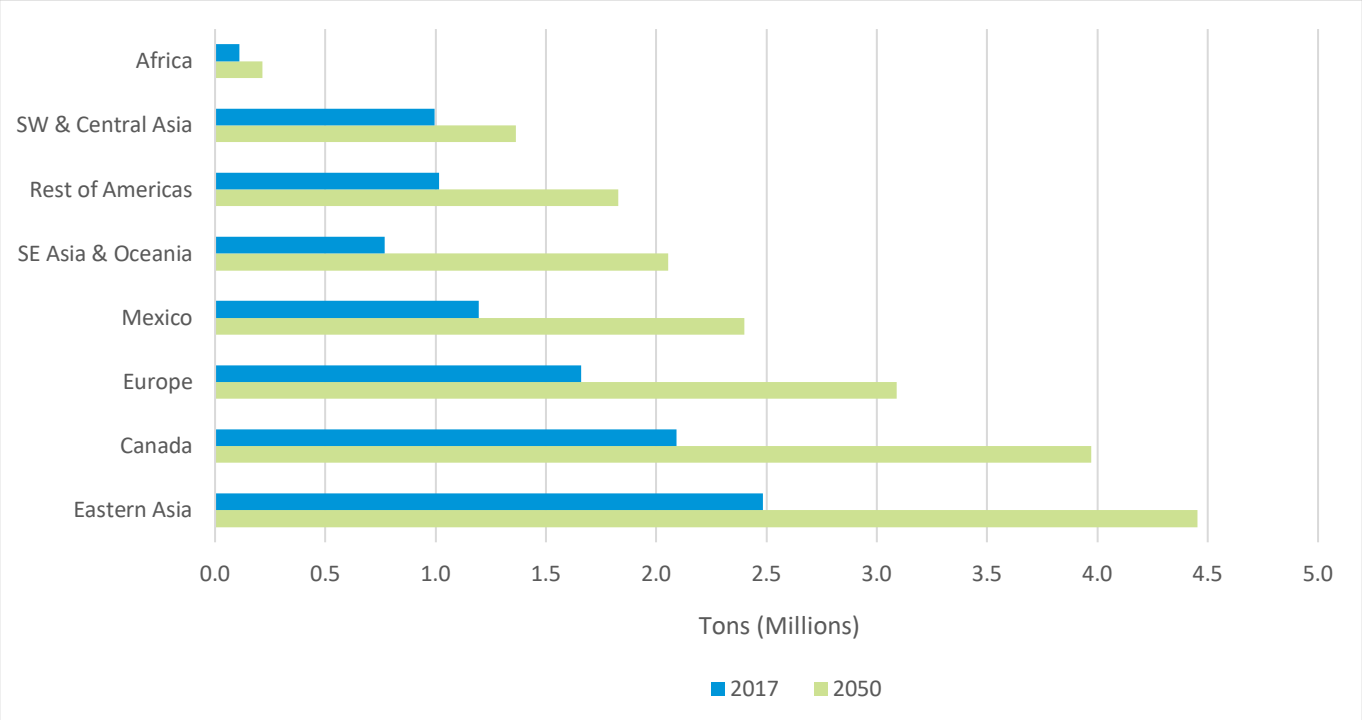
[7] United Nations Statistics Division. (2022). “Methodology: Standard County or Area Codes for Statistical Use (M49)”.

- "Mexico"
- "Rest of Americas" (south and central America, including the Caribbean)
- "Europe"
- "Africa"
- "Southwest and central Asia"
- "Eastern Asia"
- "Southeast Asia and Oceania"

North Carolina International Exports

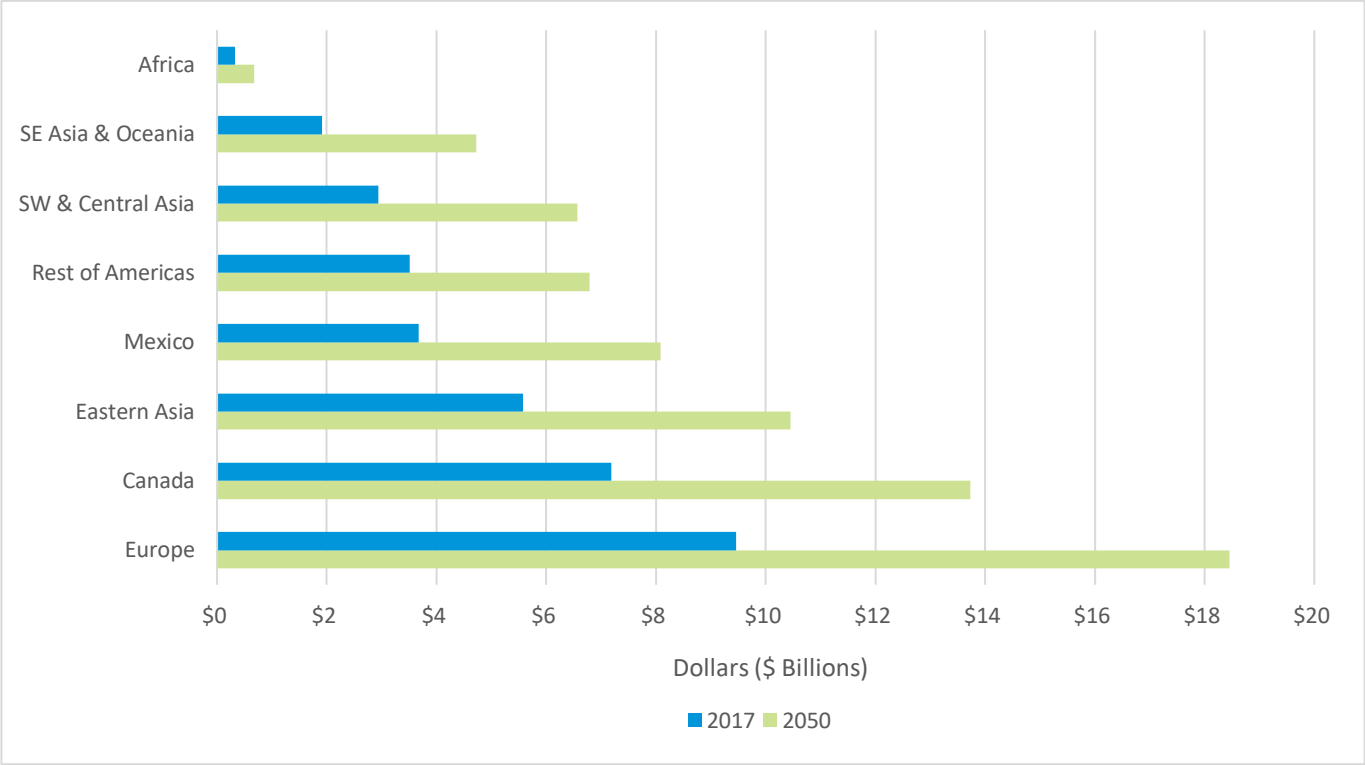
For international exports, the top three destinations in 2017 and 2050 measured by both weight and value were "Eastern Asia", "Canada" and "Europe". These three destinations accounted for 39% of the 6.2 million tons of exported goods by weight and 56% of the $22 billion exported by value in 2017. By 2050, total exports by weight are projected to nearly double from the 2017 SMFP to 11.2 million tons worth $42.6 billion, with the top three destinations remaining the same. Foreign trade partners for North Carolina exports via any United States port in 2017 and 2050 are shown in Figure 4.5 and Figure 4.6 for total weight and value, respectively.

FIGURE 4.5 NORTH CAROLINA INTERNATIONAL DESTINATIONS BY WEIGHT, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FIGURE 4.6 NORTH CAROLINA INTERNATIONAL DESTINATIONS BY VALUE, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

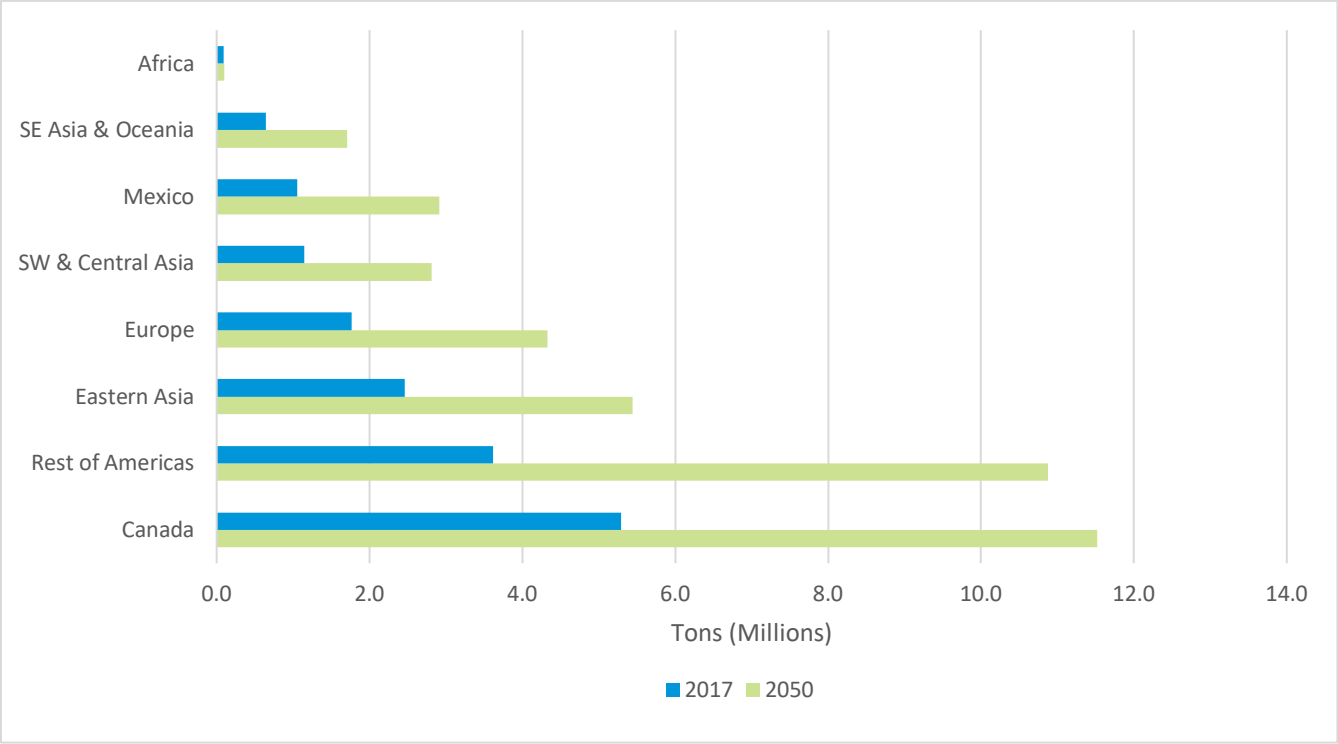
In the 2017 SMFP, the top international destinations by weight and value were also “Eastern Asia”, “Canada” and “Europe”. These top three locations by weight and value are projected to remain the same in 2050 as they were in 2045.

North Carolina International Imports

In 2017, North Carolina imports into state ports totaled 16 million tons. The top international trading partners for these imports were Canada, “Rest of the Americas” (does not include Mexico) and “Eastern Asia”. By weight, “Canada” was the leading source for international goods in 2017. Combined with “Europe” and “East Asia”, these three foreign origins accounted for approximately 11.4 million or 71% of the imported tonnage. Total imported weight in 2050 is projected to grow to nearly 40 million tons, with “Canada” accounting for 29% of the total tonnage. Figure 4.7 shows the import trading partners by weight in 2017 and 2050.

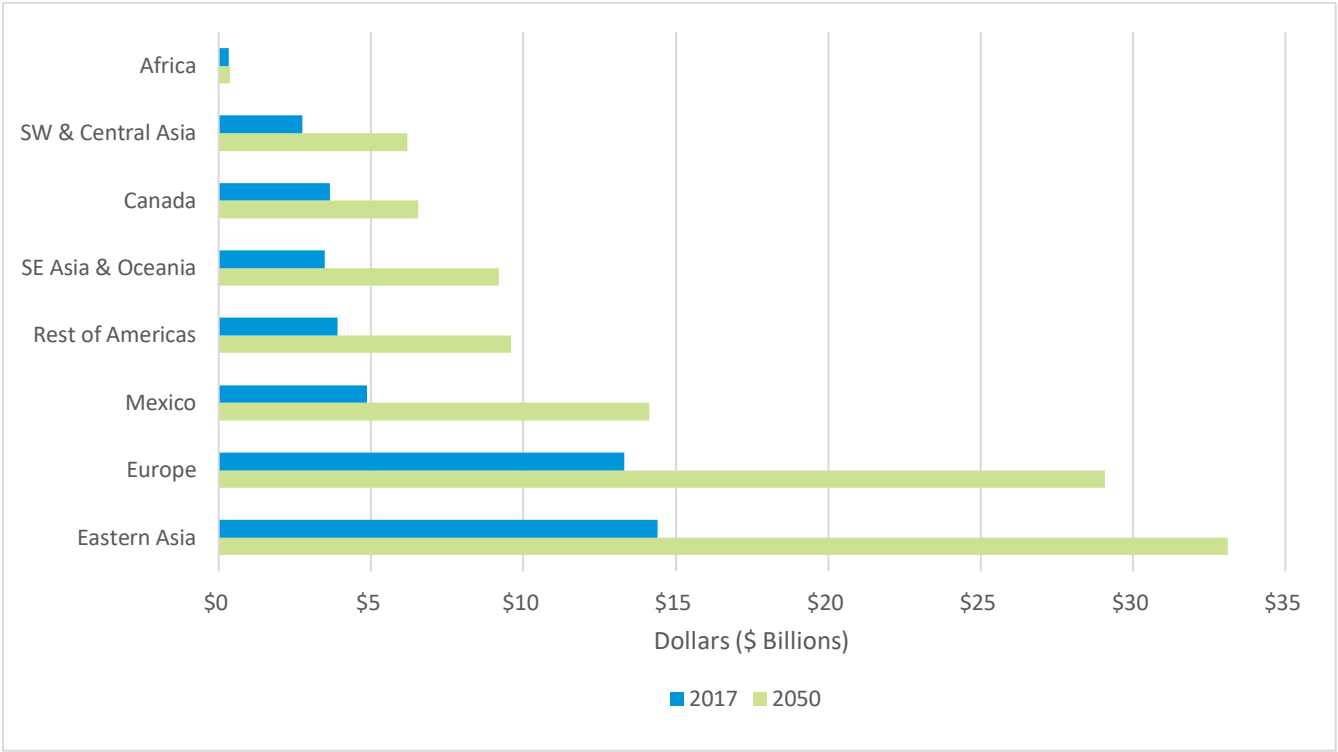
By value, imports totaled $46.6 billion in 2017. The top three imports trading partners by value were “Eastern Asia”, “Europe” and “Mexico” together accounting for $32.6 billion or 70% of the imports. By 2050, the total value of North Carolina imports is projected to increase by 132% to $108 billion. “Eastern Asia” will account for almost one-third of that increase. Figure 4.8 shows the import trading partners by value in 2017 and 2050.

FIGURE 4.7 NORTH CAROLINA INTERNATIONAL ORIGINS BY WEIGHT, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FIGURE 4.8 NORTH CAROLINA INTERNATIONAL ORIGINS BY VALUE, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

In 2012 and 2017, “Canada”, “Europe” and the “Rest of Americas” made up the top international origin locations. For 2045, “Eastern Asia” is projected to become the top international origin by weight whereas it is projected to be the third largest international commodity contributor by weight in 2050. As many U.S. firms intensify their diversification away from China in terms of sourcing, other eastern Asia countries remain attractive. Kearney’s annual Reshoring Index, which tracks trends in manufacturing returning to the United States from the 14 Asian typical low-cost countries (LCCs) and regions where sourcing, production, and assembly have been offshored, shows a negative Reshoring Index for two years in a row, reversing and cancelling out the 2018–2019 move into positive territory triggered by the US–China trade war[8]. For international commodities by value, “Europe”, “Eastern Asia” and “Mexico” were the top international locations in 2012 and 2017. For 2045 and 2050, “Eastern Asia” is projected to be to be the top international commodity origin location followed by “Europe” and “Mexico” respectively.

[8] https://www.kearney.com/operations-performance-transformation/us-reshoring-index

5.0 STATEWIDE FREIGHT DEMAND

In 2017, 727 million tons of freight valued at $956 billion moved over North Carolina's transportation system, an increase of 22% from the 594 million tons of freight in 2012 and a slight decrease of 4.6% from the $1 trillion in value in 2012.

In 2012, the top five commodities accounted for more than 224 million tons of freight annually, approximately 38% of the total freight weight moved in the state. In 2017, the top five commodities by weight were high weight, low value by weight commodities. The top five commodities are used heavily by the construction industry and accounted for more than 318 million tons of freight annually, nearly 44% of the total freight weight moved in the state. With North Carolina commodities increasing in weight moved on the freight system, the result was the total value of goods moved on the freight system decreased by 4.6% from 2012 to 2017.

By 2050, it is projected that North Carolina's transportation system will carry more than 1.14 billion tons of freight annually, valued at $1.86 trillion, an increase of 94% by tonnage and 57% by value compared to 2017.

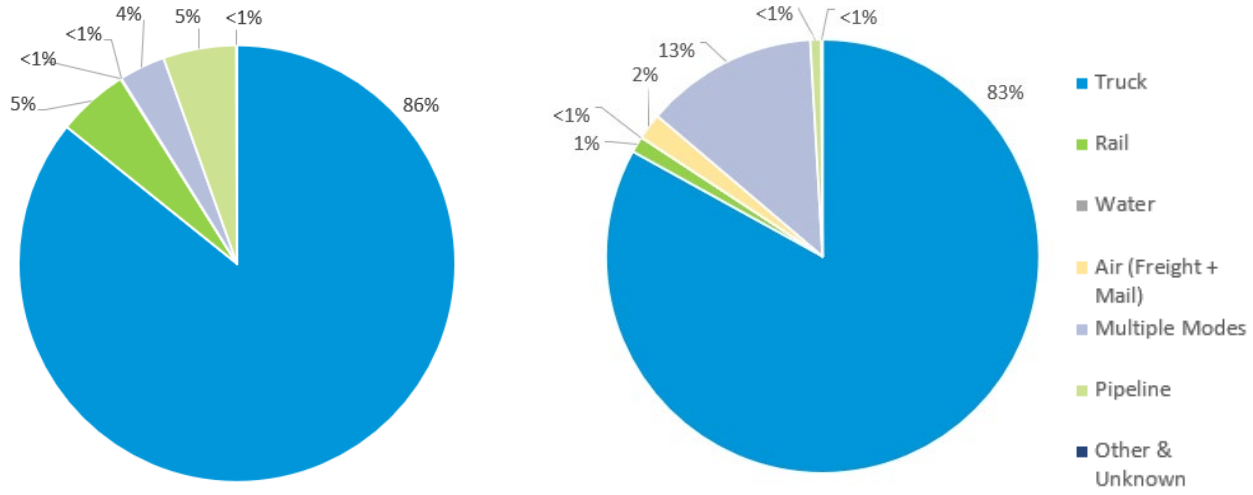
5.1 Modal Split

There were 727 million tons of freight moved in North Carolina in 2017. Trucking is the dominant mode, moving an estimated 86% of the total volume of goods, up 7% in mode split from 79% in 2012. Rail and Pipeline both represent 5% of the mode split, with the other modes representing lower mode splits.

There were $956M in value of freight moved in North Carolina in 2017. Trucks were the dominant mode utilized for the movement of these goods at 83%, up 1% in mode split from 82% in 2012. Multiple Modes was the second highest mode used at 13%. Multiple Modes represents cargo moved using more than one mode.

This modal split by both weight and value for 2017 is shown in Figure 5.1.

FIGURE 5.1 NORTH CAROLINA WEIGHT AND VALUE BY MODE, 2017

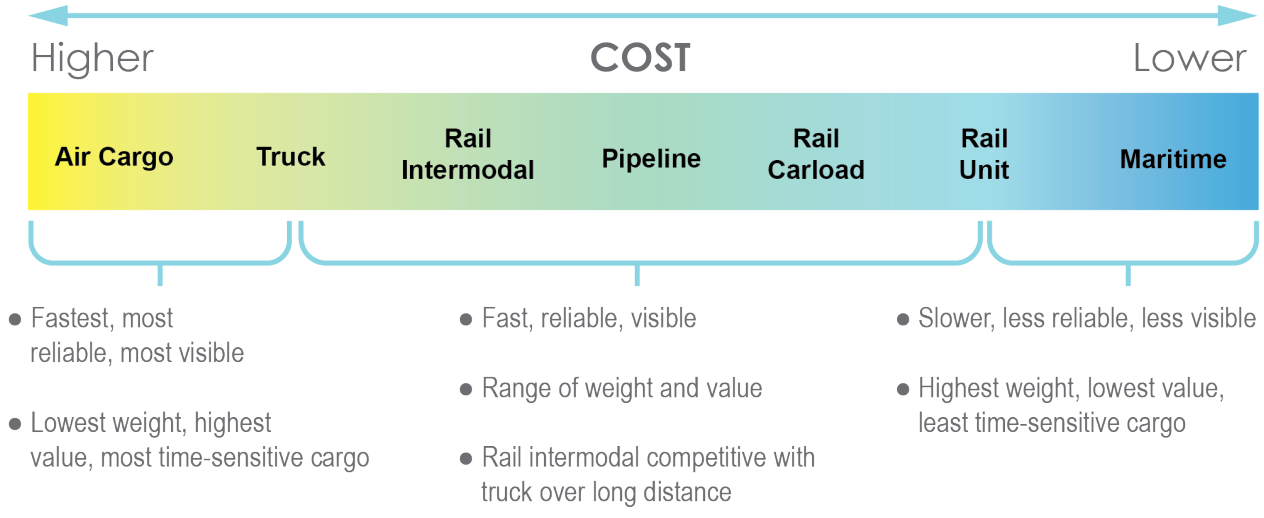


2017 Total Weight: 727 million tons **2017 Total Value: $956 million**

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

The divergence in modal choice measured by weight and value follows the goods movement spectrum shown in Figure 5.2. Air cargo offers fast transit times, higher supply chain visibility, and enhanced security for higher value goods. Rail Unit, and maritime transportation are used to move less time-sensitive goods, which are primarily bulk, commodities at a lower cost. Trucks, Rail Intermodal, Pipeline, Rail Carload and Rail Units offer a balance between cost and travel time depending on the specific scenario when acting as the primary mode of transportation.

FIGURE 5.2 GOODS MOVEMENT SPECTRUM



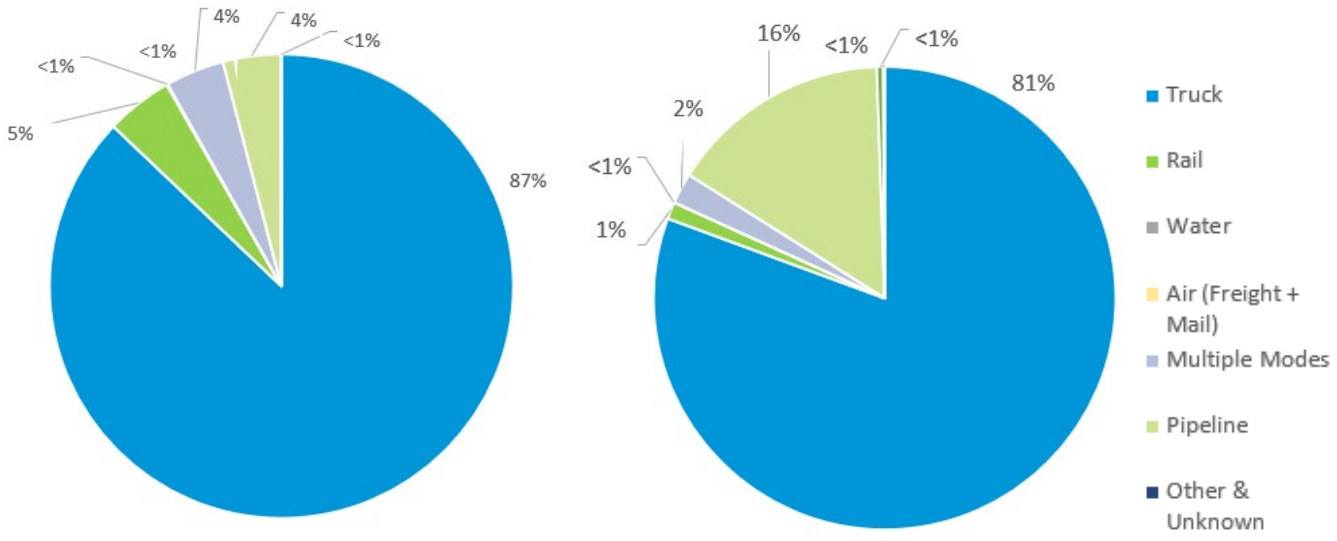
Source: HNTB.

According to FAF5.2 data, modal projections for 2050 show a similar story by weight. The total amount of goods shipped to, from, within and through North Carolina is expected to increase by 57% from 2017 to 2050 to 1.14 billion tons. Although the total tonnage carried by each mode is projected to increase, modal share will shift based on the forecast trends for the commodities carried by each mode. Trucks are expected to carry roughly the same percent of shipments (approximately 87%) compared to 2012 while rail carload share is expected to remain the same as previous years at 5%.

A different story emerges when examining projected goods movement measured by value. All modes will see an overall increase in value moved with the total value of goods projected to reach slightly more than $1.86 trillion by 2050 and increase of 94% by tonnage compared to 2017. Truck modal share is projected to account for 81% of the total value of goods moving in North Carolina. Rail intermodal's share is expected to represent 1% of the moves in 2050. Maritime shipments are projected to remain constant from 2017 to 2050 at 1%. Air cargo value, which also includes truck-air shipments,[9] is projected to remain the same from 2017 to 2050 as well. Goods moved by mode in 2050 by weight and value are shown in Figure 5.3.

The FAF5.2 values are in constant dollars so long-term inflation is included in the values. While the United States is experiencing high inflation in 2022, it is not projected to continue and certainly for the purpose of projecting to 2050 using the historical consumer price index is reasonable.

FIGURE 5.3 NORTH CAROLINA WEIGHT AND VALUE BY MODE, 2050



2050 Total Weight: 1.14 Billion tons

2050 Total Value: $1.86 Trillion

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

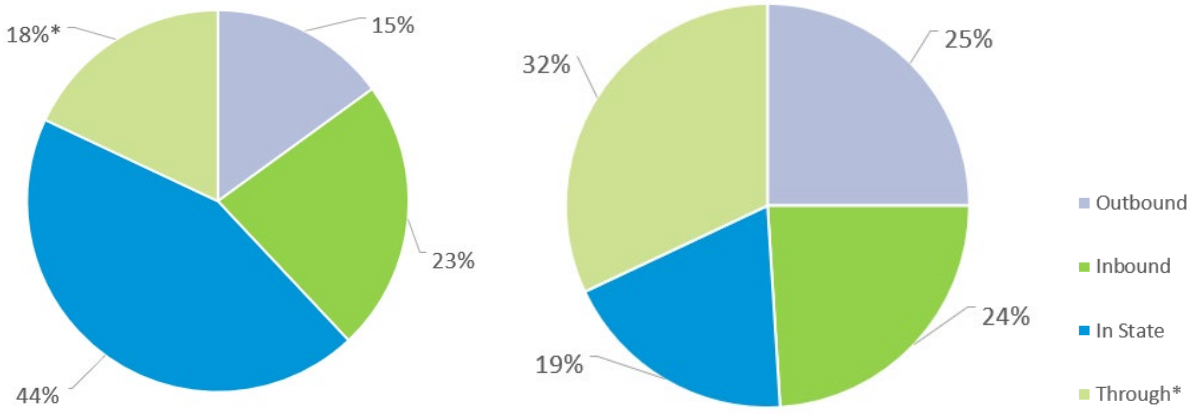
9 Includes shipments typically weighing more than 100 pounds that move by air or a combination of truck and air in commercial or private aircraft. Includes air freight and air express.

5.2 Directional Split

By weight in 2017, in-state shipments accounted for 44 % of the 727 million tons moved, the largest percent of any direction. Imported shipments accounted for the next highest direction at 23%, followed by through shipments and exported shipments accounting for 18% and 15%, respectively, of the total tonnage moving in the state. The through values were based on FAF 4.1 through percentages by weight and value due to the through values not being available in the FAF5.2 dataset at the writing of this SMFP. The through values are denoted with a "*" next to the through value percentage in Figure 5.4 and Figure 5.5.

When measured in value, the highest total value of goods move through the state (32%), followed by exported shipments (25%), imported shipments (24%) and intrastate shipments (19%). The direction of goods movement by weight and value are in line with the previous SMFP. Figure 5.4 shows the direction split by weight and value for goods movement in North Carolina in 2017.

FIGURE 5.4 NORTH CAROLINA DIRECTION OF GOODS MOVEMENT WEIGHT AND VALUE, 2017

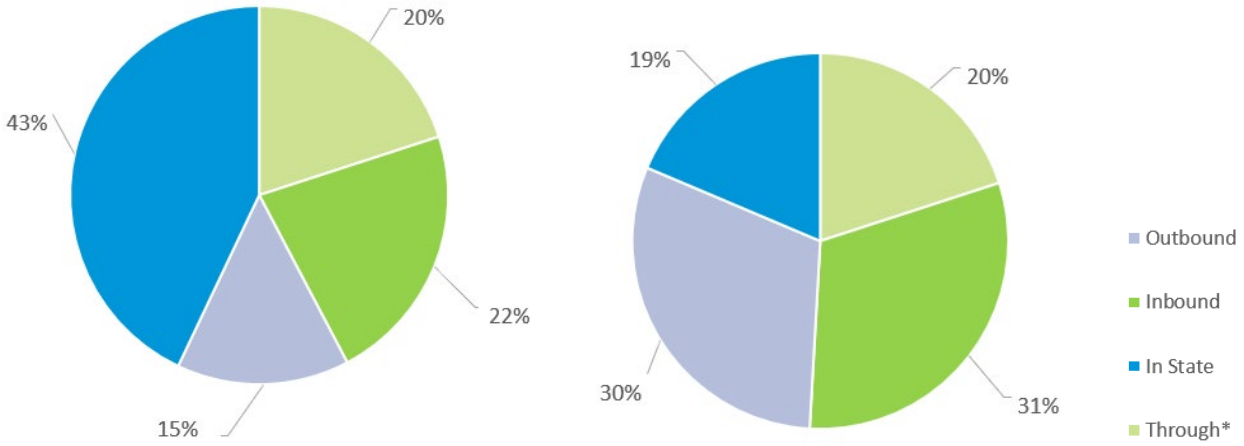


2017 Total Weight: 727.4 million tons **2017 Total Value: $956.4 million**

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

Projected directional splits for 2050 remain mostly consistent with the 2017 SMFP. By weight, the total tonnage of imported shipments is projected to decrease by 2%, with a corresponding decrease in exported shipments and an increase in in-state shipments. As companies continue to multi-shore, source their inputs from multiple locations, to increase the resiliency of their supply chains, some of that manufacturing capacity is projected to be developed in North Carolina. Additionally, the change in the commodity mix also impacts the directional flow, For example, as less and less coal is imported into the state, the imported tonnage share is expected to decline. By value, imported and exported shipments are expected to increase while in-state shipments decrease compared to the 2017 SMFP. Figure 5.5 shows the projected direction split by weight and value for 2050.

FIGURE 5.5 NORTH CAROLINA DIRECTION OF GOODS MOVEMENT WEIGHT AND VALUE, 2050



2050 Total Weight: 1.14 Billion tons **2050 Total Value: $1.86 Trillion**

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

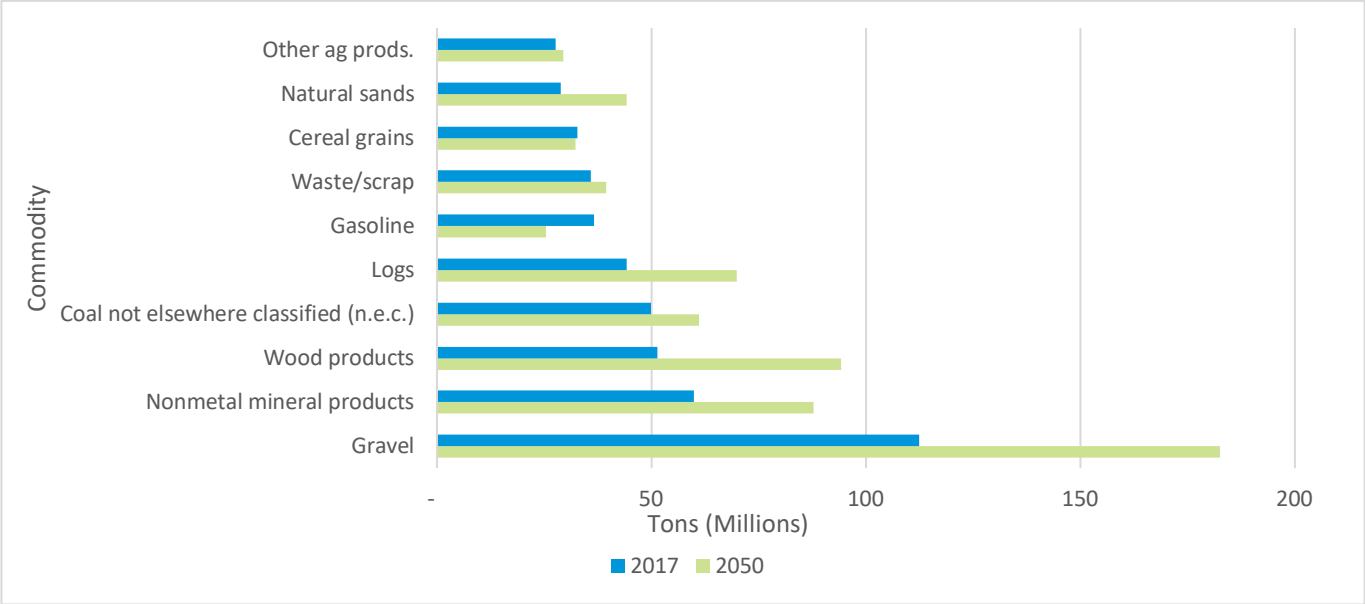
5.3 Top Commodities

By weight in 2017, the top commodity that moved to, from, within and through North Carolina was gravel and crushed stone[10], accounting for 15% of the total weight of all goods. The other top five products are all similar bulk commodities and include non-metallic mineral products, wood products, and coal products and logs. These five commodities, used heavily in the construction industry, account for more than 318 million tons of freight annually, or nearly 44% of the total weight moved.

In 2050, the top commodities moved by weight are all projected to increase in tonnage. The aforementioned top five commodities combined will account for approximately 44% of all shipments (495.5 million tons). Gravel is projected to have the largest increase amongst the top commodities in tonnage moved between 2017 and 2050 (from 112 million tons to 183 million tons). Figure 5.6 shows the top 10 commodities moved in North Carolina by weight for 2017 and their project growth by 2050.

10 For a complete list of goods included in each category, refer to the Standard Classification of Transported Goods (SCTG) codes produced by the U.S. Census.

FIGURE 5.6 NORTH CAROLINA COMMODITIES BY WEIGHT, 2017 AND 2050



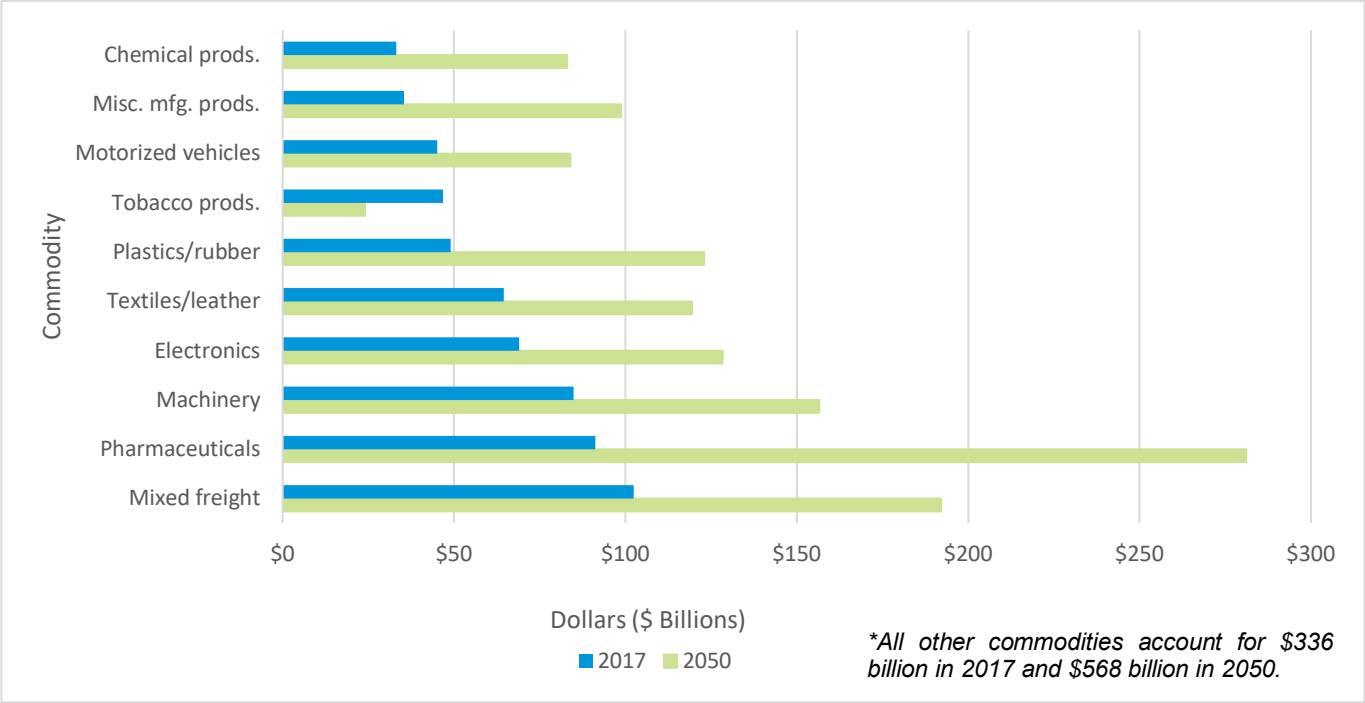
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

In the 2017 SMFP, gravel was also the top commodity by tonnage for 2012 but was not the top commodity by tonnage for 2045, as it is predicted to be for 2050. The top commodity for 2017 SMFP was predicted to be nonmetal mineral products followed closely by coal not elsewhere classified (n.e.c.).

As shown in Figure 5.7, the top transported commodity by value in 2017 was mixed freight, followed by pharmaceutical products, machinery, electronics and textiles / leather products. These five commodity types accounted for $411.9 billion or 43% of the total value moved.

The top commodities (mixed freight, machinery, electronics, textiles/leather and plastics/rubber) by value are projected to nearly double by 2050. Pharmaceuticals will dominate, accounting for approximately 15% of the total value of goods moved, followed by mixed freight, machinery, electronics and plastics/rubber. The top five products combined will account for 47% or $1.86 trillion of the total value of all goods moved in the state. Figure 5.7 shows the top 10 commodities moved by value in 2017 and their projected growth by 2050.

FIGURE 5.7 NORTH CAROLINA COMMODITIES BY VALUE, 2017 AND 2050



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

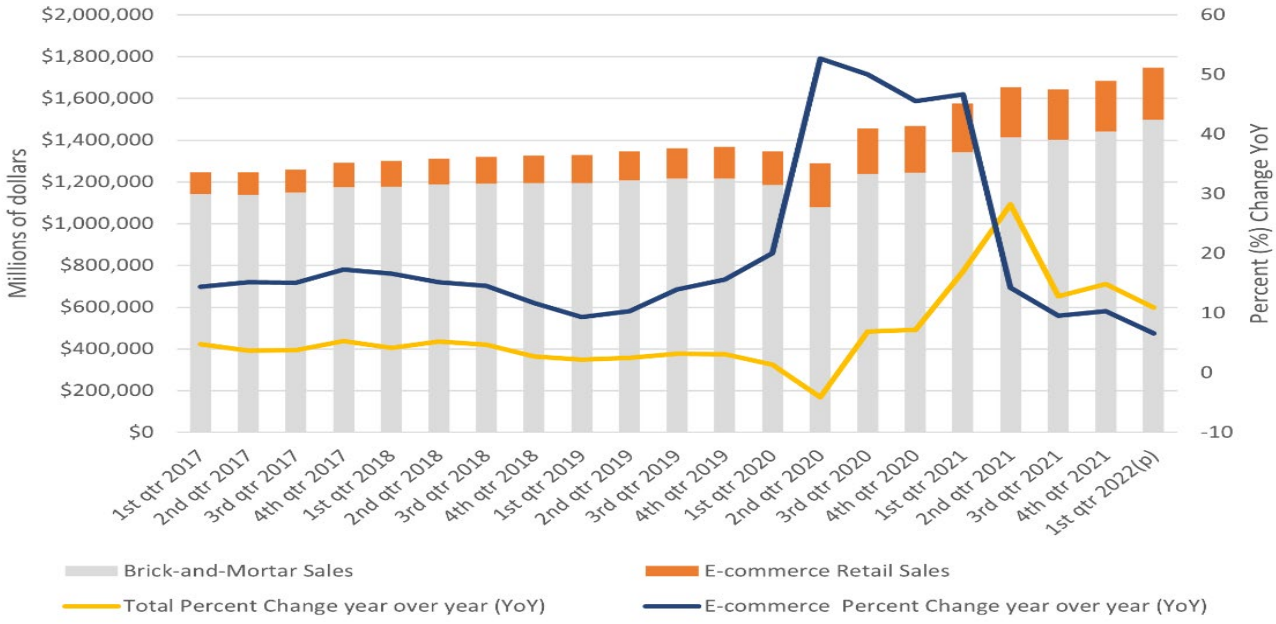
The top five commodities by value remained the same from the 2017 SMFP for the base year and projected year. These commodities are mixed freight, pharmaceuticals and machinery. In the 2017 SMFP, mixed freight was the top commodity by value in 2012 and is the top commodity by value in 2017 (Figure 5.7). The top projected commodity by value for 2045 was mixed freight. In 2050, the top projected commodity by value is pharmaceuticals. This is due to North Carolina having many major pharmaceutical companies located in the state and confirmed during airport stakeholder interviews.

5.4 E-Commerce

E-commerce is a strategy of business-to-consumer (B2C) and business-to-business (B2B) sales that leverages digital platforms instead of brick-and-mortar marketplaces. How businesses and consumers buy and sell goods is crucial to the freight industry and the utilization of North Carolina's multimodal freight network. Consumer spending habits continue to contribute to the growing demand for e-commerce products. This affects business as well as land use and zoning. Over the past decade, the promise (and, in some cases, guarantee) of fast delivery for nearly every product imaginable has transformed how people purchase many types of goods, adding to the convenience of making purchases at any time of day from the comfort of home.

E-Commerce retail sales were $960 billion nationally in 2021, an 18.3% increase over 2020 and a 68.5% increase over 2019. E-commerce represented 14.6% of all retail sales in 2021 in the United States (Figure 5.8).

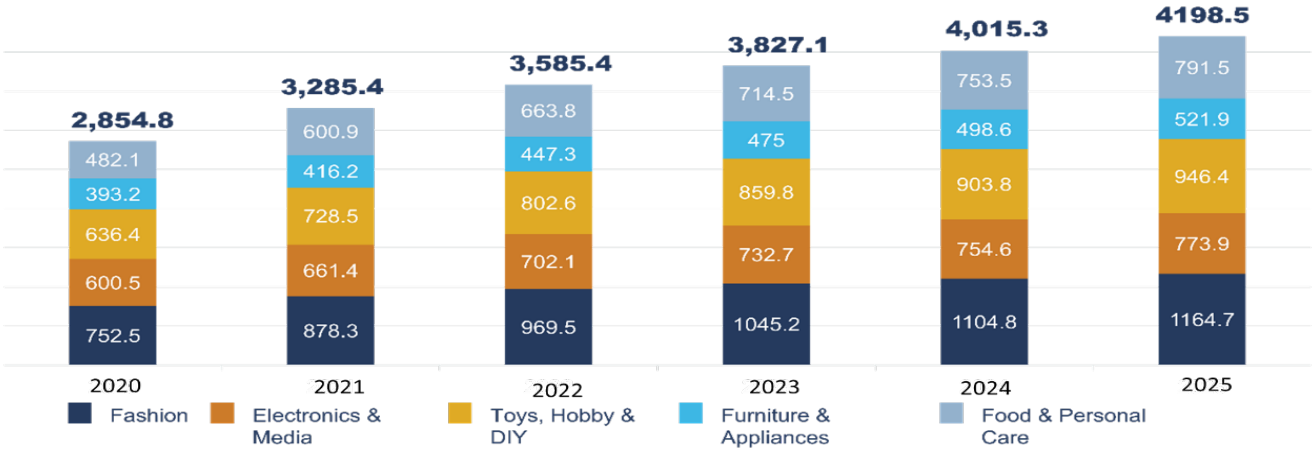
FIGURE 5.8 ESTIMATED QUARTERLY U.S. RETAIL SALES (ADJUSTED): E-COMMERCE AND BRICK AND MORTAR (2017-2022)



Source: *Retail Indicators Branch, U.S. Census Bureau.*

The types of goods consumers are buying via e-commerce have changed significantly over the last few years. Figure 5.9 presents recent and forecasted global e-commerce sales by major consumer good category. Overall, e-commerce sales are projected to grow by 32% between 2020 and 2025. Food and personal care was the fastest growing e-commerce commodity group from 2020 into 2022, fueled by the global COVID-19 pandemic which led to in-store shopping restrictions and a pivot to grocery delivery services. It is projected that growth in e-commerce sales of food and personal care items will continue to outpace other categories through 2025. However, all categories are expected to experience robust growth in e-commerce sales.

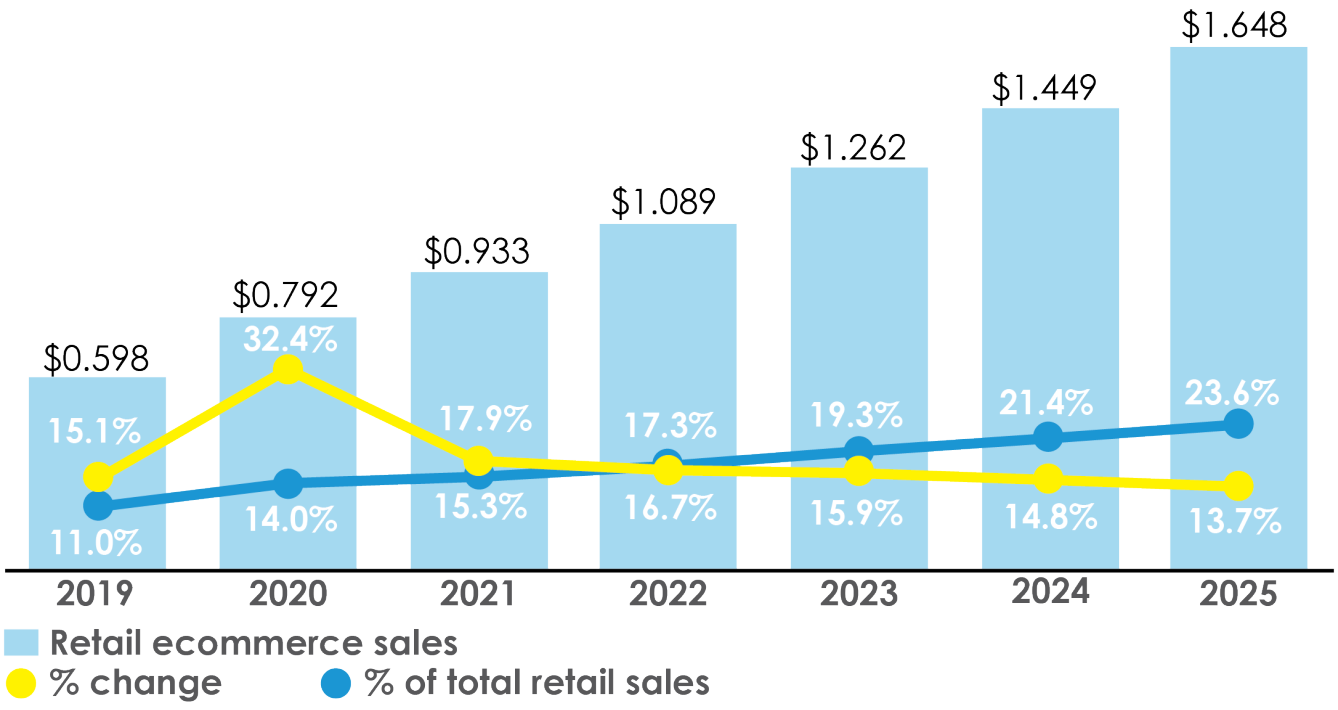
FIGURE 5.9 RECENT AND FORECASTED GLOBAL E-COMMERCE SALES BY CATEGORY (TRILLIONS $)



Source: U.S. International Trade Administration.

E-commerce sales in the United States are projected to grow at twice the rate as global e-commerce sales, expanding by 64% between 2019 and 2025 (Figure 5.10). The percentage of total sales comprised of e-commerce sales is projected to be nearly 24% in 2025, compared to only 11% in 2019.

FIGURE 5.10 U.S. E-COMMERCE SALES AS PERCENT OF TOTAL SALES, 2019-2025



Source: eMarketer, May 2021.

Implications for Freight Movements

In response to massive supply chain disruptions beginning in 2020, as a result of COVID, inventory management strategies are pivoting from just-in-time delivery to increasing inventory levels. These transformations in the supply chain management will have impacts on local land use and traffic patterns. As businesses add inventory to their stockpiles as well as their distribution to consumers, this could result in less pressure to use more costly trucks and integrate rail for transporting more consumer products.[11] While increasing the usage of rail has many positive impacts in terms of reducing roadway congestion and emissions, it also leads to increased community concerns. Trains are getting longer, averaging an increase of 25% from 2008 (1.2 miles) to 2017 (1.4 miles) which translates to more blocked crossings for longer periods of time in areas with at-grade highway-rail crossings, and a need to modernize many urban rail facilities.[12] Additionally, the Bipartisan Infrastructure Law (BIL) calls for further research on the safety impacts of longer trains.[13]

Another impact on land use will be on the production side. The location of new businesses spurred by increased domestic manufacturing will increase demand for industrial space throughout the state, potentially necessitating land use changes for corridors to meet production and distribution demand for various industries (e.g., agriculture, manufacturing). Many suppliers and shippers will prioritize locating near key corridors, such as I-40, I-74, I-85 and I-95, water and inland ports, and airports. Additionally, they will seek land that already has access to utilities including water, electricity, natural gas, and broadband, making some rural North Carolina counties more challenging to develop. Facilities needed to support increases in e-commerce are typically looking to be located in close proximity to population centers, such as Charlotte, Raleigh-Durham and Asheville where land is scarce and more expensive. As they get priced out of urban markets, they will locate on the fringes of those markets, potentially leading to increased truck vehicle miles traveled on the network.

Trucks continues to dominate as the most utilized mode in the United States, representing 71% share by value, and 64.6% of mode share by tonnage.[14] E-commerce goods are heavily dependent on trucks after arriving via container at United States coastal ports. Although some containers are transported via rail to inland destinations, most are transferred to trucks at intermodal facilities before reaching a retailer's warehouse or distribution facility prior to re-sorting for final delivery to the customer. In addition to existing intermodal facilities in the Charlotte, Greenville and Raleigh-Durham areas, CSX's Central Carolina intermodal terminal recently opened and will serve as a truck to rail transfer point for goods traveling along the east coast. To mitigate costly frequent trips in smaller trucks and vans, shippers are choosing to diversify options for "last-mile" deliveries to homes and businesses by adopting or testing new fulfillment methods such as lockers, delivery pick-up locations, delivery robots, and unmanned aerial vehicles (UAVs).

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[11] Wall Street Journal. (June 15, 2018). "Why Railroads are Making Freight Trains Longer and Longer."

[12] U.S. Government Accountability Office. (2019). Rail Safety: Freight Trains are Getting Longer and Additional Information is Needed to Assess Their Impact.

[13] Trains. (November 15, 2021). Railroads' Use of Long Trains to Go Under the Microscope."

[14] U.S. DOT. Bureau of Transportation Statistics and Federal Highway Administration. (2019). Freight Analysis Framework, version 4.5, 2019.

Nationally, air cargo represents a much smaller share of tonnage at 0.03% but has a higher value share (3.4%) than shipments by water (2.1%).[15] North Carolina is known as the state that was "first in flight" and has a rich history in aviation services and innovations. Air cargo has been the fastest growing mode for freight movement over the past decade, thanks in large part to the just-in-time manufacturing rise in global outsourcing. At the height of the pandemic air shipments of personal protective equipment and vaccines were crucial to stemming the tide of disruption. Even passenger planes were being used more to move shipments as COVID-19 effectively halted passenger air travel. As we move beyond the pandemic, air cargo continues to be a fast growing and critical component supporting North Carolina's freight movement and the supply chains of its key industry sectors.

One area of continued development is consumer returns, which are accelerating demand for reverse logistics solutions in the industry. Reverse logistics refers to the path products take from the end consumer back to the seller or manufacturer. Retailers' returns processing costs are skyrocketing, according to the National Retail Federation. On average, it now costs $33 or 66% of the price of a $50 item for retailers to process a return—up from 59% last year. Consumers often desire and expect liberal return policies, while retailers are facing pressure to process returns as inventory, and quickly mark items as "in stock" as soon as they reach the warehouse. Wal-Mart has invested heavily in automation to reduce the labor and time it takes to move returned products back to store or warehouse shelves. As the supply chain adjusts to reverse logistics, the shifting demands at warehouses and fulfilment centers will result in changing smaller truck and passenger traffic patterns to return-processing sites.

[15] U.S. DOT. Bureau of Transportation Statistics and Federal Highway Administration. (2019). Freight Analysis Framework, version 4.5, 2019.

6.0 SUMMARY

North Carolina boasts diverse freight-generating industries and commodity flows which serves populations in every part of the state. The NCPFN (consisting of freight interstates, highways, rail lines, inland ports, seaports and airports) connects many of the freight generating industries in the state leading to increased movement of goods to, from and through the state. North Carolina's freight system's needs are driven by existing and future freight demand. This report presented existing (2017) and potential future (2050) demand for freight in the state and compared the data to the previous 2017 SMFP which used existing (2012) and future (2045) planning horizon year data. The following provides a brief summary from each of the primary sections of the Commodity Flow profile.

- **Freight Generators** Section illustrated the location, employment size and fleet size of freight generating industries in North Carolina. The freight generators are of interest to the Freight Plan due to the traffic and logistics measures they add to the priority freight network in North Carolina. Key takeaways from this analysis included:

  Most North Carolina freight generator companies are relatively small with a small fleet size.
  - 99% of the more than 316,000 freight generating employers have fewer than 250 employees
  - 92% of freight generating vehicle fleets are 10 vehicles or less
  - The Service / Public Administration Industry makes up 47% of all freight generating industries

- **FAF5.2 Zone Level Freight Demand** Section examined North Carolina's existing and projected freight activity at the FAF5.2 zone level, including the top zones generating freight by weight and value. The key takeaways from this analysis were that the areas outside of the three largest metropolitan areas of "Greensboro-Winston-Salem-High Point", "Charlotte" and "Raleigh-Durham" make up the largest importer and exporter of freight by weight and value in 2017 and 2050. The "Rest of North Carolina" FAF zone accounted for 48% of the total weight and 36% of the total value in 2017. In 2050, this FAF zone is projected to account for 49% of the total weight and 40% of the total value of all freight commodities in the state.

- **North Carolina's Trading Partners** Section identified the state's top domestic and international trading partners for freight imports and exports. Key takeaways from this analysis were:

  Domestic trade has grown significantly since the previous Freight Plan.
  a. In 2017, North Carolina sent nearly 474 million tons of goods to destinations outside the state throughout the United States, which was a nearly 400% increase from 2012 reported in the previous Statewide Multimodal Freight Plan completed in 2017.
  b. The top domestic destinations for freight in 2017 were the rest of South Carolina (12%), the rest of Virginia (8%) and Virginia Beach-Norfolk Virginia (7%) by weight. By 2050, the top three destinations are projected to remain the same.

  International trade remains strong with eastern Asia, Canada and Europe.
  c. In 2017, international trade accounted for approximately 26.4 million tons of the goods shipped to and from North Carolina worth over $81 billion.
  d. For international exports, the top three destinations in 2017 and 2050 measured by both weight and value were eastern Asia, Canada and Europe.

e. The top three import trading partners by value were eastern Asia, Europe and Mexico together accounting for $32.6 billion or 70% of the imports.

- **Statewide Freight Demand** Section provided an overview of existing and projected demand for freight transportation in North Carolina, including modal split, directional analysis and top commodities moving in the state. Key takeaways from this analysis included:

  Truck traffic remains the dominant mode of travel in North Carolina.

  a. In 2017, trucks were the dominant mode of freight movement in the state representing 86% of the mode split by tons and 83% of the mode split by value. The values were expected to be similar in 2050.
  b. In 2017, 44% of freight moved within the state by weight, whereas only 19% of freight moved within the state by value.
  c. In 2017, the top commodity that moved to, from, within and through North Carolina by weight was gravel and crushed stone, accounting for 15% of the total weight of all goods.

APPENDIX

A. FAF5.2 Database Methodology for North Carolina

This Appendix discusses the methodology of the FHWA's FAF5.2 database, for use in the Plan. Figure A.1 shows the United States FAF5.2 zones.

The FAF5.2 regional flows that are domestic (i.e. not imports and exports through a United States Port of Entry/Exit) are disaggregated to Federal Information Processing Standard (FIPS) counties. Flows that are imports and exports through a water port are distributed to the water ports in that FAF5.2 region based on the share of the two-digit Standard Classification of Transported Goods (SCTG2) total weight served by that port in the United States Army Corp of Engineers (USACE) Navigational Data Center Waterborne Commerce database[16]. Flows that are imports or exports by rail or truck at border crossings with Canada or Mexico are distributed to rail or highway border crossings in that FAF5.2 region, with the same factor for each SCTG2 commodity, based on the reported trucks (for the FAF5.2 truck mode) or trains (for the FAF5.2 rail mode) at that border crossing as reported by BTS's Border Crossing/Entry data. For imports or exports through FAF5.2 regions that are not border crossings or water ports, the original FAF5.2 region as a port of entry is retained. FAF includes information which could be used to disaggregate flows imported or exported by air, however there are only six FAF5.2 regions that contain multiple airports. These six zones have data for only the total tonnages and do not include data for tonnages by import, exports and domestic are known.

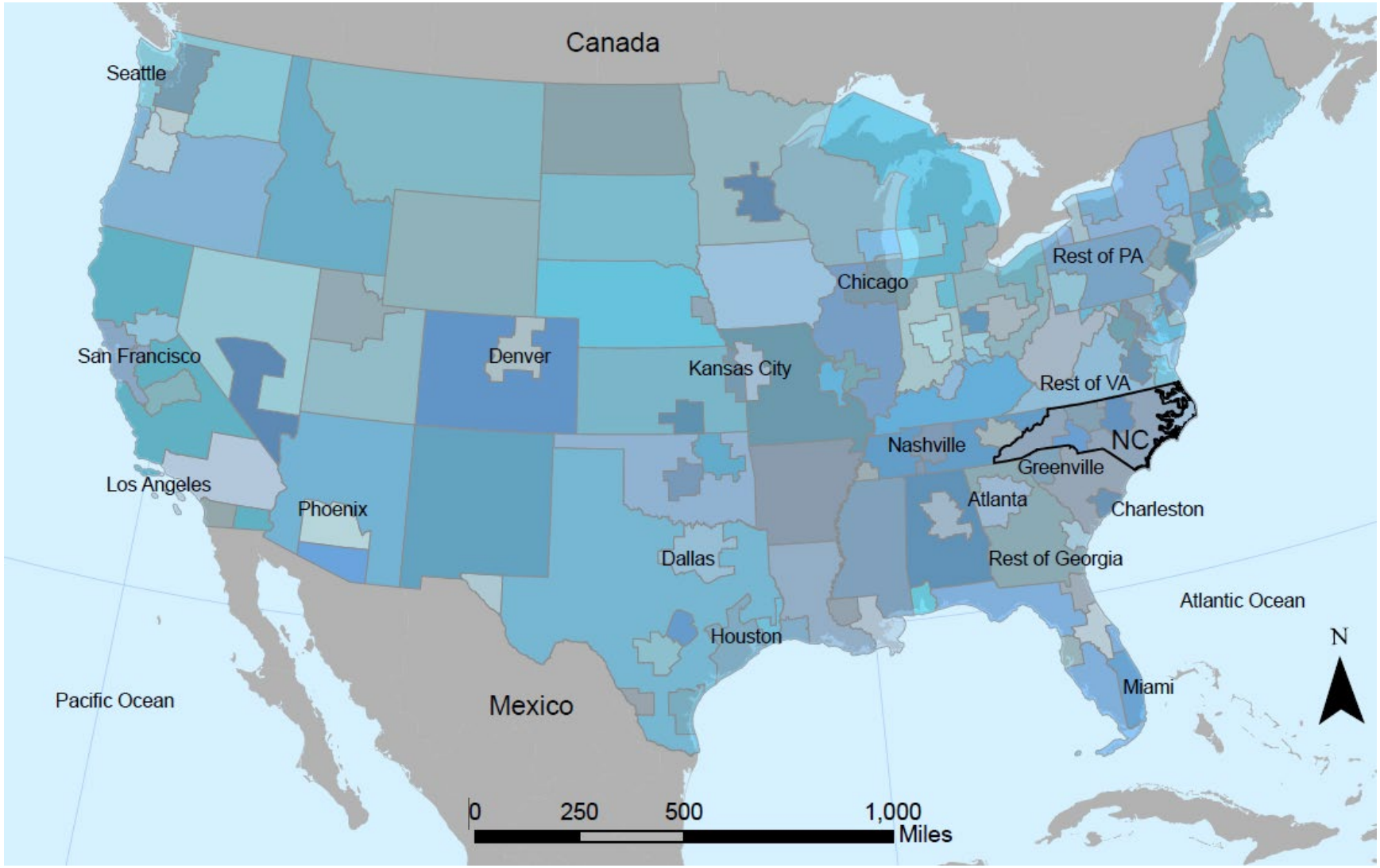
The database includes a table called "FIPS & Ports/Borders to FAF5.2 Regions all". This table incorporates the FAF5.2 regions in which all FIPS counties, water ports and border crossings are located for the entire country. For North Carolina, only the information germane to the state is output from the tool. For example, even though factors are available to allocate from a FAF5.2 region to land border crossings with Canada and Mexico exists, there is no such border crossing on the North Carolina border and thus no import or export flows would be disaggregated to those nonexistent border crossings. By contrast, in the FAF5.2 region 379 - Rest of NC there are two ports, Wilmington and Morehead City, and the factors for these ports are utilized.

A.1 Through Flows

The FAF5.2 data only outputs the flows to, from and within a study area such as North Carolina. The trips that pass through a study area, but have no cargo stops within the study area, cannot be determined from the FAF5.2 data. For the through values in this report, the FAF4.1 percentages were used from the previous North Carolina 2017 Statewide Multimodal Freight Plan. Through values are not expected to be part of the FAF5.2 data.

[16] Prior to 2014, only total tonnages for commodities were reported electronically by the USACE and only a single factor for all commodities was used for each port. Beginning with 2014, flows were reported by commodity by waterway, including ports and those are now used to develop disaggregation factors.

FIGURE A.1 FAF5.2 ZONES IN THE UNITED STATES



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

A.2 FAF5.2 Variable Field Terms

The Microsoft Access (MS Access) database includes a link to the "faf41_data" table in the official FAF5.2 MS Access database. That "faf5_data" table includes the following fields:

1. **Fr_orig:** Foreign region of shipment origin, if any is on record. The foreign zones are those specified in the FAF and consist of 8 international zones, two of which are the countries of Canada and Mexico.
2. **Dms_orig**: FAF region or state where a freight movement begins the domestic portion of shipment. For imports, this is the United States entry region where an import enters the United States.
3. **Dms_dest**: FAF region or state where a freight movement ends the domestic portion of shipment. For exports, this is the United States exit region where an export leaves the United States.
4. **Fr_dest:** Foreign region of shipment destination, if any is on record. The foreign zones are the same as those described above under "Fr_orig".
5. **Sctg2:** The commodity being reported in that record according to the SCTG. This is reported at a two-digit level.
6. **Dms_mode:** The mode used for domestic transportation according to the coding convention in FAF5.2. The coding conventions for mode in FAF5.2 are listed below in Table A.1.
7. **Trade_Type:** The type of movement of that record as: 1- Domestic Only; 2- Import or 3- Export. This information should be consistent with the foreign origins and destinations of that record.

TABLE A.1 FAF5.2 MODES

FAF5.2 Mode Code	FAF5.2 Mode Name
1	Truck
2	Rail
3	Water
4	Air (include truck-air)
5	Multiple modes & mail *
6	Pipeline
7	Other and unknown

*Note: * This replaces the truck-rail (i.e., intermodal rail) mode used in FAF2. It also includes commodities reported as mail and water-rail or water-truck multiple mode movements.*

8. **TonsXX:** Total weight of commodities shipped (unit: Thousand Tons). The flow in annual tons for that record in the year 20XX. These years include the surveyed flow in 2017 and projected future flows for 2050.
9. **ValueXX:** Total value (in 2017 constant dollars) of commodities shipped (unit: Million dollars). The value in annual millions of United States dollar value in the year 20XX. The same years as above for tons are included for value.
10. **Tons17:** The flow in annual kilotons for that record in the year 2017.
11. **Tons50:** The flow in annual kilotons for that record in the year 2050
12. **Value17:** The value in annual millions of $2017 in the year 2017.
13. **Value50:** The value in annual millions of $2017 in the year 2050.

The MS Access database queries were developed to arrive at the needed data to populate this Commodify Flow profile. This was accomplished by:

- creating a crosswalk table for non-North Carolina zones,
- extracting and creating tables of the North Carolina records from the FAF5.2.
- creating a table of disaggregated records for the study area.

If there are any border crossings or water ports within the study area, the flows are reported for those facilities. In North Carolina there are two water ports and no border crossings. This will disaggregate all imports and exports by water. It does not identify the specific facilities that are used by other import or export modes. Typically, there is only one freight airport per FAF.15 region, and those flows would thus not need to be disaggregated. A of air imports and exports was necessary for the “Rest of NC” FAF5.2 Zone 379 and the BTS TranStats Database T-100 Market air cargo data for each North Carolina airport was used to disaggregate the FAF5.2 air cargo data.