



## NORTH CAROLINA

Department of Transportation



## The Supply Chain for Economic Development

Dana Magliola  
Freight & Logistics Program Manager  
NCDOT Supply Chain SME  
October 26, 2021

# Introduction

Dana Magliola

- Program Manager, Freight & Logistics, NCDOT Rail Division
- NCDOT Supply Chain SME
- Maritime, freight forwarding, applied research background
- *Connecting transportation strategy, planning and investment to commerce and industry*



MAERSK



*If you have questions, please type them into the chat and I'll keep an eye on it. We'll have time for questions at the end.*

# Objectives

- To strengthen the supply chain, freight, and logistics expertise and capabilities of the business development and industry recruiting professionals in the North Carolina Economic Development Association
- To introduce key supply chain concepts, current issues, best practices, trends and future developments in the sector

# Agenda

- Key focus areas within supply chain management
- Inventory + Working Capital
- Distribution, warehousing, and network design for site selection/development
- Transportation, freight + logistics: know your mode

2020's been like:



# Hype Cycles

## Hype Cycle for Emerging Technologies, 2020



[gartner.com/SmarterWithGartner](https://gartner.com/SmarterWithGartner)

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Gartner.

## The Privacy Panic Cycle for New Technologies







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Tuesday, October 26, 2021  
Today's Paper

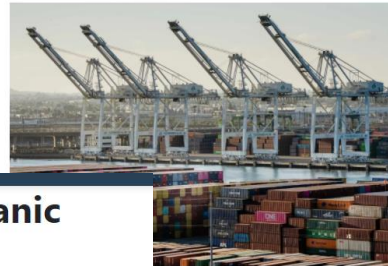
## The New York Times

Nasdaq

World U.S. Politics N.Y. Business Opinion Tech Science Health Sports Arts Books Style Food Travel Magazine T Magazine Real Estate Video

## Rising Prices, Once Seen as Temporary, Threaten Biden's Agenda

- Supply chain disruptions, a worker shortage and pain at the gasoline pump have made inflation an economic and political problem for the White House.
- Rising prices have complicated President Biden's push to expand the social safety net and could hurt Democrats' chances in the midterm elections next year.



Los Angeles this month. Eric Schaff/The New York Times

## Going Back to Eat in Midtown, Where the Main Dish Is New York

This often-maligned neighborhood is pulsing with a variety, energy and deep history that is the city's essence.



## National alcohol shortage may re-ignite panic buying

Supply chain issues are impacting alcohol production



By Haley Weger

Published: Oct. 25, 2021 at 11:30 PM EDT | Updated: 9 hours ago



Lake Charles, LA (KPLC) - Supply chain issues are impacting the alcohol supply in the U.S. This is more difficult for bars and liquor stores to get.

FORTUNE RANKINGS MAGAZINE NEWSLETTERS PODCASTS COVID-19 MORE

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FINANCE · SUPPLY CHAIN

## Supply chain panic is creating a vicious cycle of shortages

By NATALIE MULLIN  
October 22, 2021 10:03 PM EDT

## Related Articles

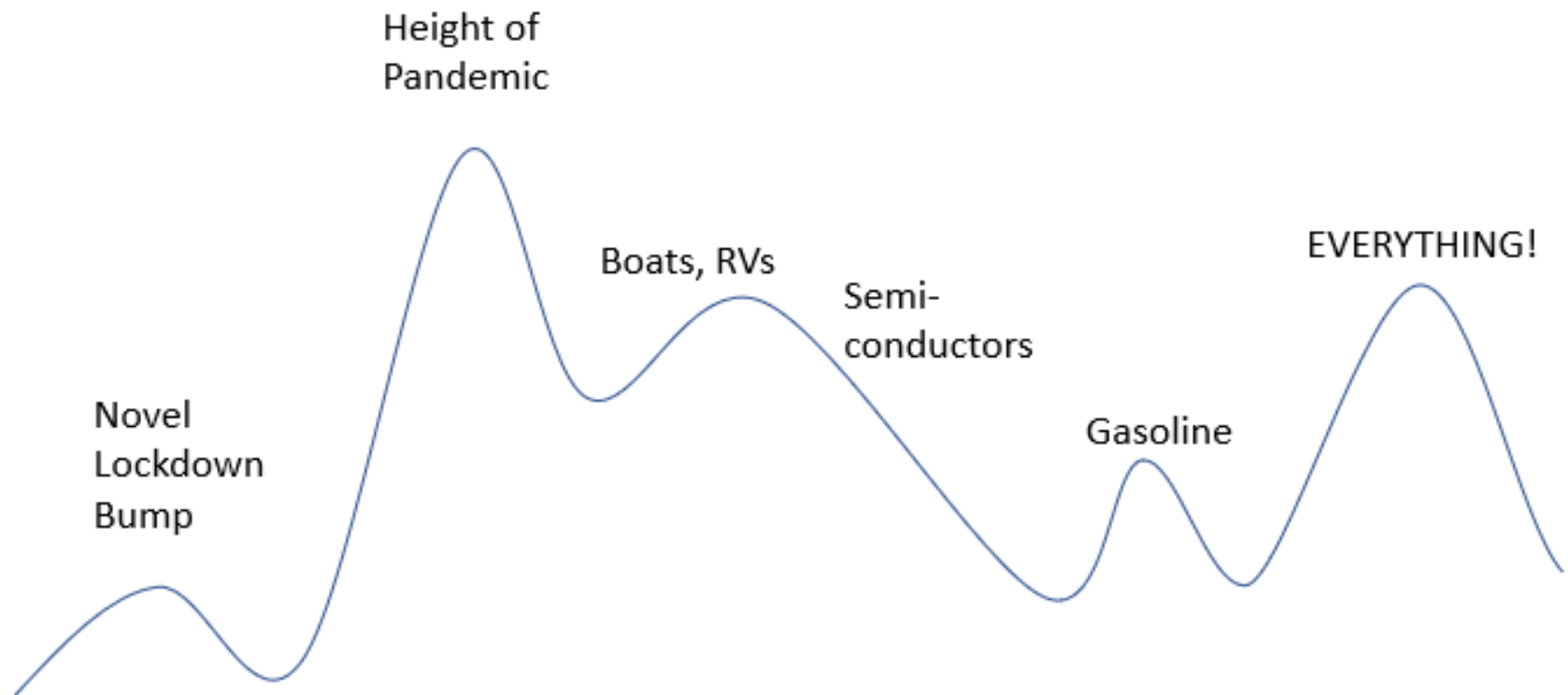
**CONSEQUENCES**  
What's causing supply chain shortages? It's not just port disruptions.

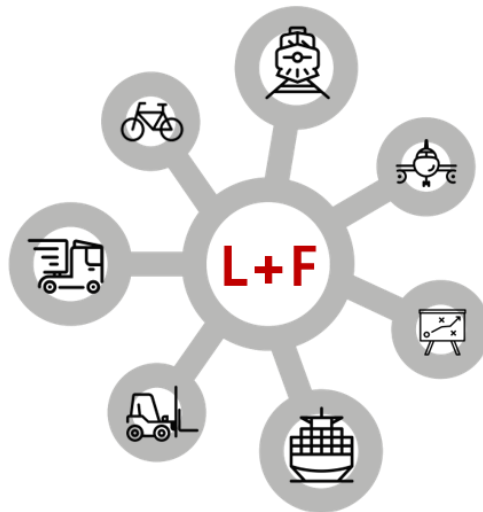
By EMMANUELLE

**FEATURE**  
No chicken suggests, no PB&J: Supply chain issues are in the news at schools across the country.

October 2, 2021  
By ALEXANDRO FLORES

# Supply Chain Panic Hype Cycle™





## Key Focus Areas within Supply Chain Management



# Elements of the Supply Chain



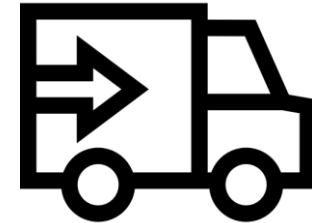
## Procurement

- Sourcing
- Forecasting
- Vendor Qualification
- Negotiation
- Contracting
- Purchasing
- Cost Control & Analysis
- Quality
- Finance



## Production

- Manufacturing & Assembly
- Process Improvement
- Forecasting
- Inventory Control
- WIP Management
- Data Collection & Analysis
- Capacity/Utilization Management
- Quality



## Distribution

- Storage/Warehousing
- Transportation Management
- Material Handling
- Logistics
- Customs & Trade Management
- Inventory Management
- Customer Relations
- Return Logistics

KEY ACTIVITIES

← COMMUNICATIONS & INFORMATION SHARING →

*\* These are only some of the key activities in the supply chain. Each company's supply chain is unique.*

# Procurement



- Procurement activities may include:

- • Supplier or Material Sourcing
- Forecasting
- Vendor Qualification
- Negotiation
- Contracting
- Purchasing
- • Cost Control & Analysis
- Quality

# Procurement

## STRATEGIC SOURCING

### *Choosing a vendor*

Launches the partnership

Evaluates long-term goals

Involves lots of internal input

Focuses on vetting vendors

Big-picture, long-term thinking

## PROCUREMENT

### *Doing the work*

Extends through full relationship

Focuses on a specific need

Involves narrow group of people

Focuses on acquiring goods

Action and goal-focused approach

## Supplier or Material Sourcing

- Vendors vs. Strategic Sourcing Partnerships
- Strategic Sourcing Goods *and* Services
- Material sourcing:
  - Natural resources
  - General industrial supply base
- Vendor diversity initiatives:
  - Women, Minority, Veteran-Owned

# Procurement

## Types of Cost:

- ➡ • Capital
- ➡ • Production
  - Information
  - Inventory
- ➡ • Transportation



*Industrial rail siding at warehouse*



# Procurement

## Types of Cost: Capital + Equipment

- Real estate; zoning + land use
- Buildings (Design/build, *spec*/build to suit, retrofit)
- Equipment + machinery
- Utilities infrastructure
- Cost of capital: financial ecosystem
- Policy benefits + incentives
- Access to transportation



*Industrial rail siding at warehouse*

# Procurement

## Types of Cost: Production

- Utilization of facility, machines + equipment
- Downtime + recovery
- Workforce management
- Utilities: reliability + cost



*Caterpillar factory, Sanford, NC*



# Procurement

## Types of Cost: Transportation

- Transportation rates
- Rate volatility (spot market)
- Speed vs. cost
- Reliability + resiliency
- Third party ecosystem: 3/4PLs



*Material handling is another factor in transportation cost*

# Production

- Production activities may include:

- 
- ➔ • Manufacturing & Assembly
  - Kit construction
  - Design & Testing
  - Forecasting/Demand Planning
  - Inventory Control; WIP Management
  - Data Collection & Analysis
  - Capacity/Utilization Management
  - ➔ • Process Improvement
  - Quality/Repairs

# Production

## • Manufacturing & Assembly Processes:

- Repetitive Manufacturing
- Discrete Manufacturing
- Job Shop Manufacturing
- Process Manufacturing (Continuous)
- Process Manufacturing (Batch)
- *Additive*

The  types of manufacturing processes



# Production

## Process Improvement Methodologies

- **Six Sigma:** A data/stats-driven approach to reduce defects and improve performance/productivity
- **Kaizen** (Continuous Improvement): Six Sigma but on an organizational level; long-term, cultural
- **Total Quality Management (TQM):** company wide commitment to improve quality; strong cultural element
- **Lean manufacturing:** A systematic process to identify, minimize waste without sacrificing productivity
- **Toyota System/Just-in-time:** production aimed to reduce inventory cost, manufacturing products on demand
- **Kanban:** Lean process improvement limiting work-in-process and managing production flow using visualization
- **Theory of Constraints (TOC):** Identify limiting factors and improve systematically until the constraint is not a limiting factor



*Lean (Six) Sigma = Lean + Six Sigma*

# Distribution



- Distribution activities may include:

- Storage/Warehousing
- Packaging
- Transportation Management
- Material Handling & Logistics
- • Customs & Trade Management
- Finished Inventory Management
- Customer Relations
- • Reverse / Return Logistics



# Distribution

## Customs + Trade Management:

- US Customs + Border Protection
  - Started to manage the Tariff Act of 1930 (aka collect taxes)
  - Since 2003, focused on national security (but also collecting taxes..)
- Import / Export
  - Customs Brokerage services
  - Harmonized Tariff Schedule
  - Foreign Trade Agreements



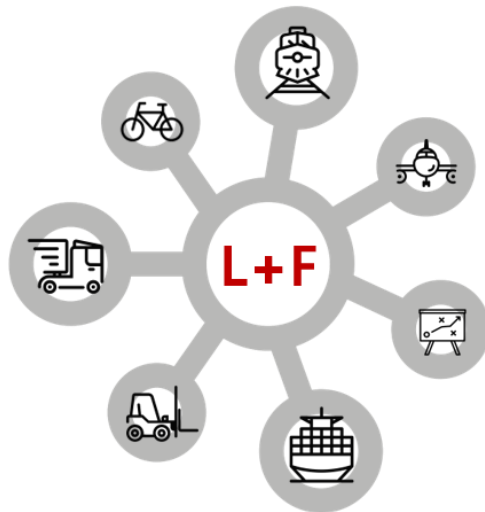


# Distribution

## Reverse or Return Logistics:

- Customer relations impact
- Contract compliance for quality
- Capture value for remanufacture or resale
- Ensure proper disposal (salvage + recycling)
- Repair products + Re-market (refurbished)
- eCommerce growth inevitably drives growth in returns
- Re-commerce

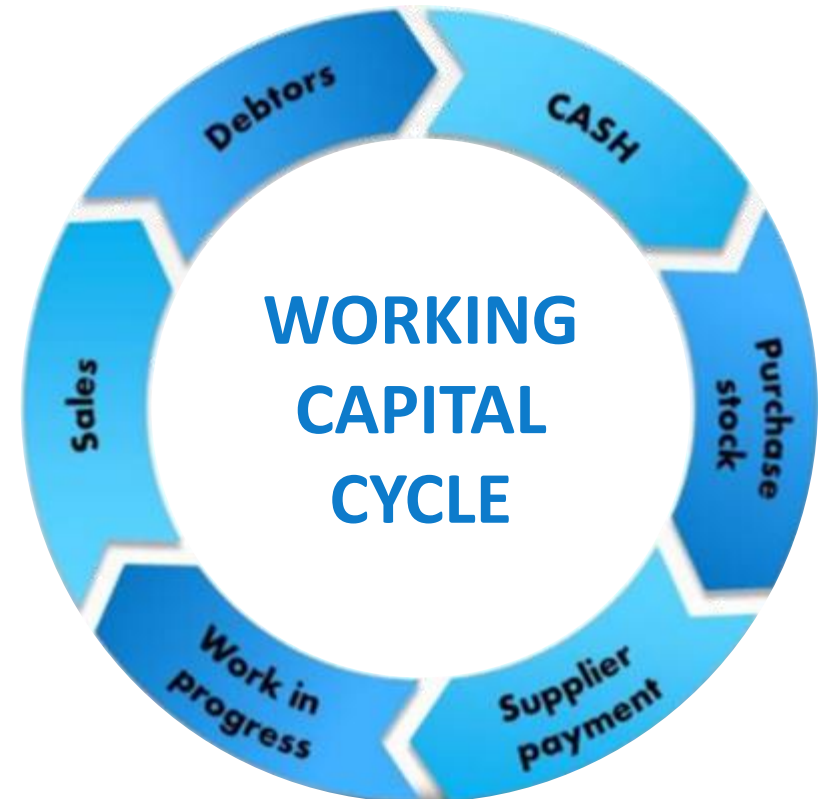


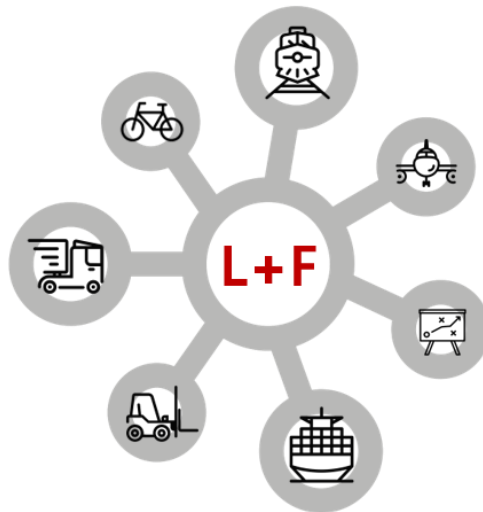


Inventory + Working Capital

# Inventory + Working Capital

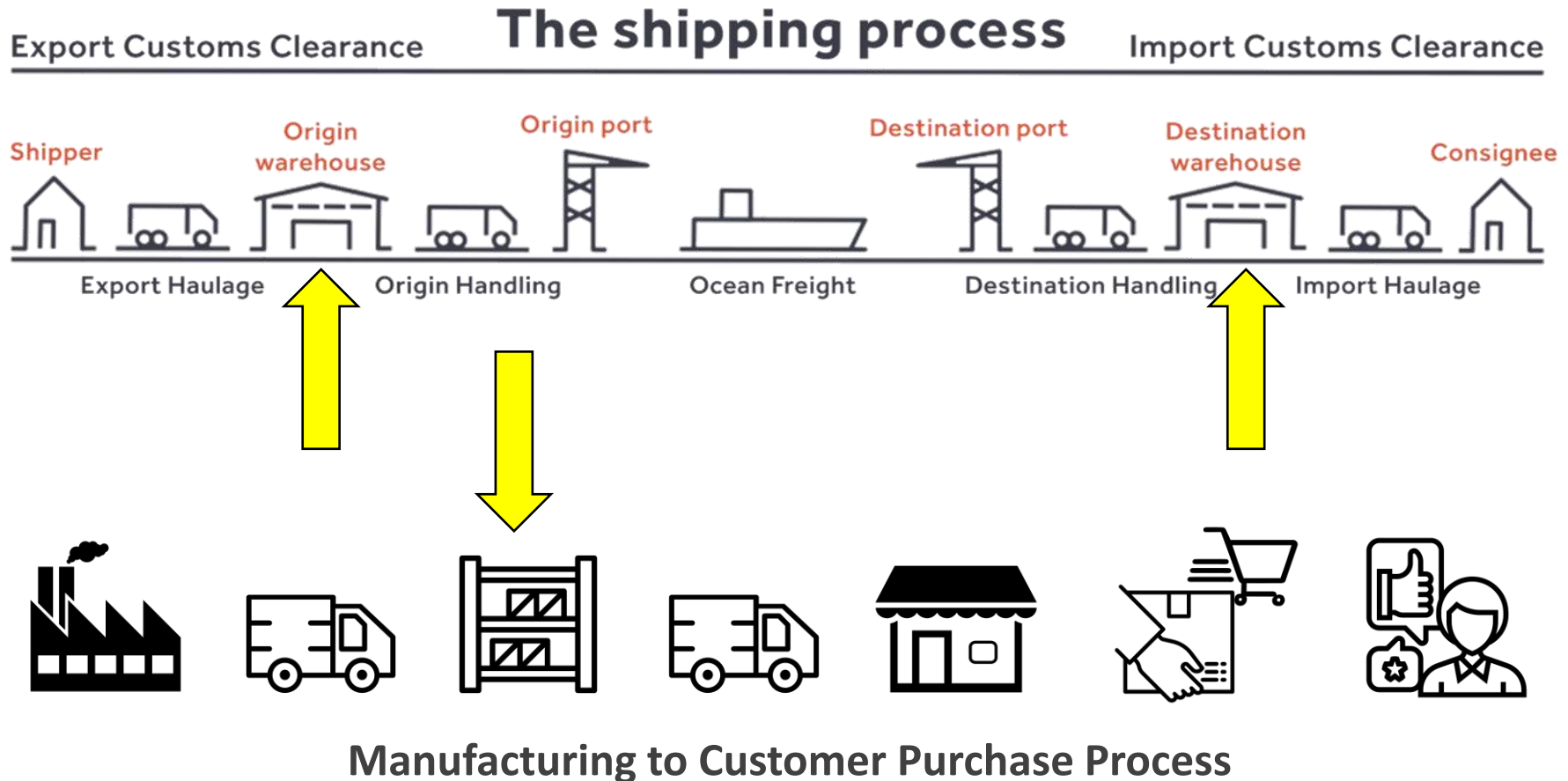
- THE supply chain trade-off
- Inventory in either finished product, WIP, or manufacture input reduces liquidity
- Inventory turnover articulates efficiency
- How can a supply chain ecosystem improve (reduce) inventory levels?
  - Improved processes: JIT, Lean, Kanban
  - Local or regional suppliers on demand
- Impact of COVID + natural disasters
  - Prevent increasing inventory





Distribution, Warehousing + Network  
Design for Site Selection +  
Development

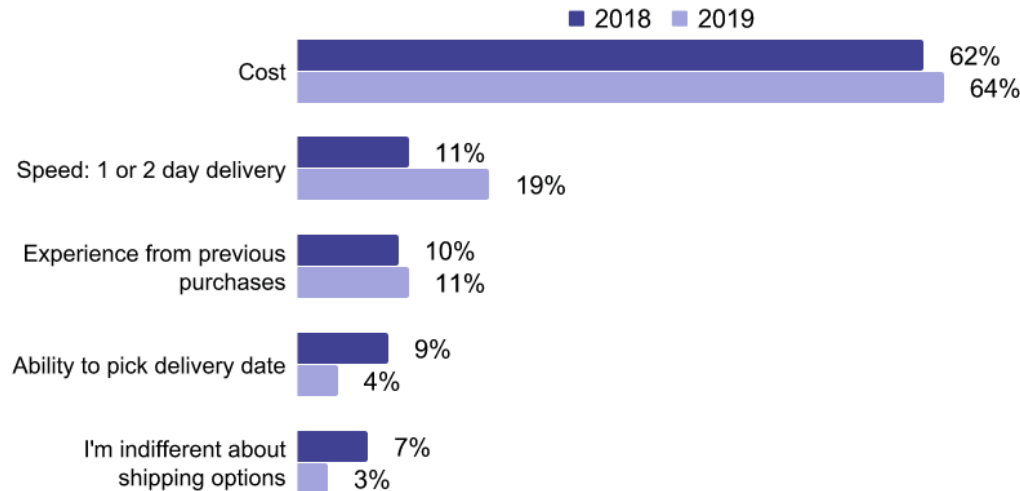
# Distribution + Warehousing



# Distribution + Warehousing

## Customer focus on speed increases in 2019

% respondents who said listed factor is the most important when picking shipping option



**Optimum facility count for required service levels in U.S. (to cover 90% of population)**

**Target service level**

**Radius covered by 1 facility**

**# of facilities needed**



**2-3 days**

**~650 miles**

**~5**



**Next day**

**~150 miles**

**40-50**



**Same day**

**~90 miles**

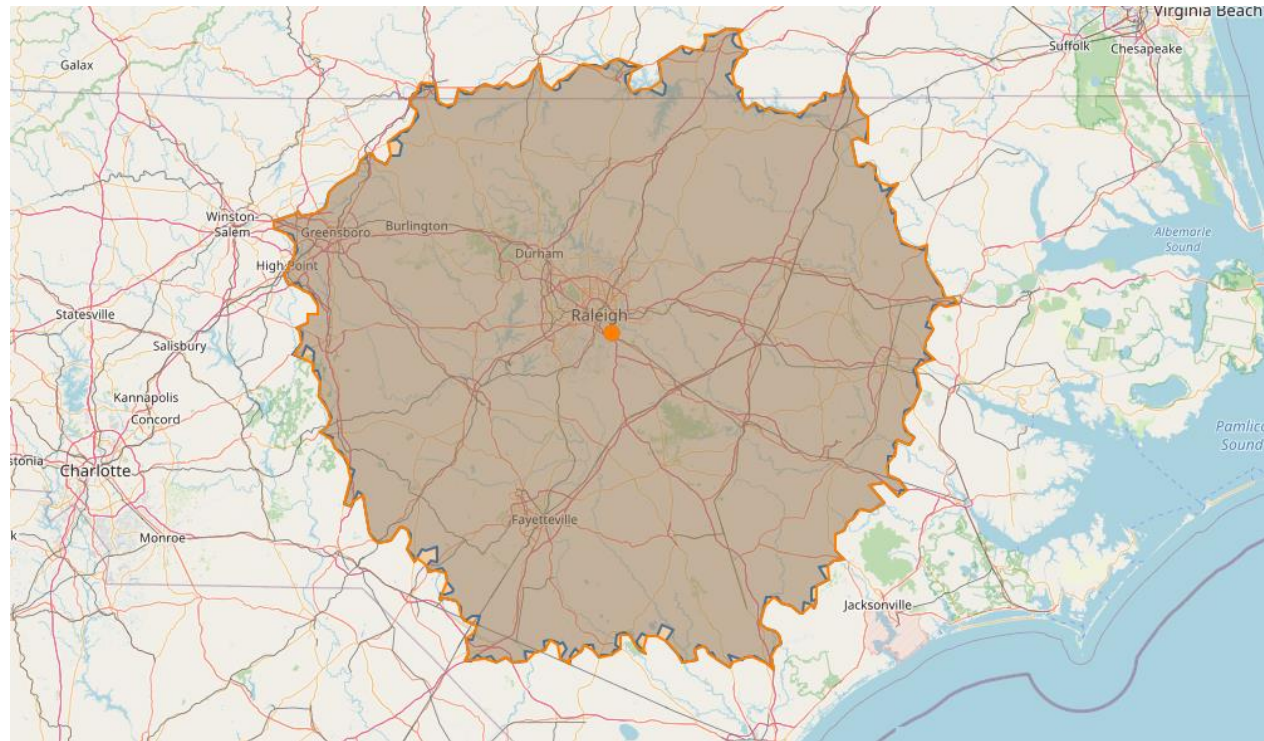
**80-100**



# Distribution + Warehousing

Level of Service drives warehouse location:

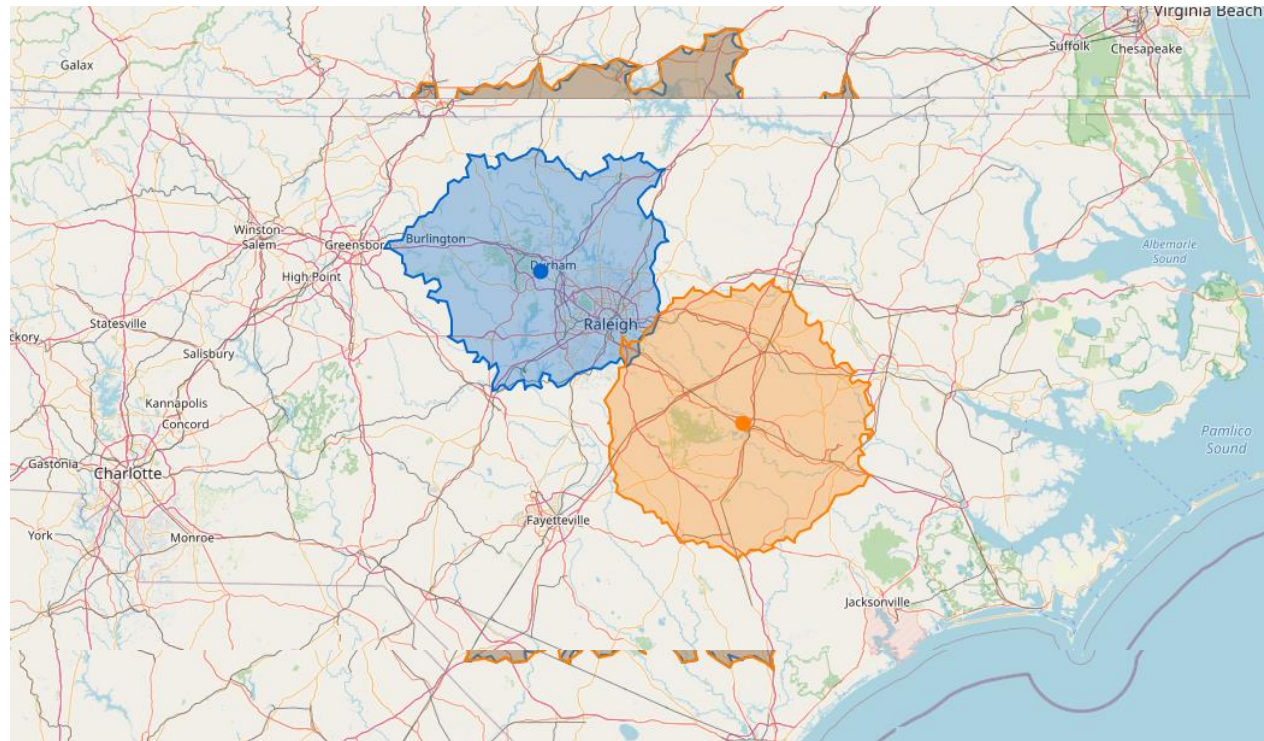
- 2-hour delivery window; Amazon DC in Garner, NC
- 1-hour delivery window; grocery DC in Durham + Goldsboro, NC



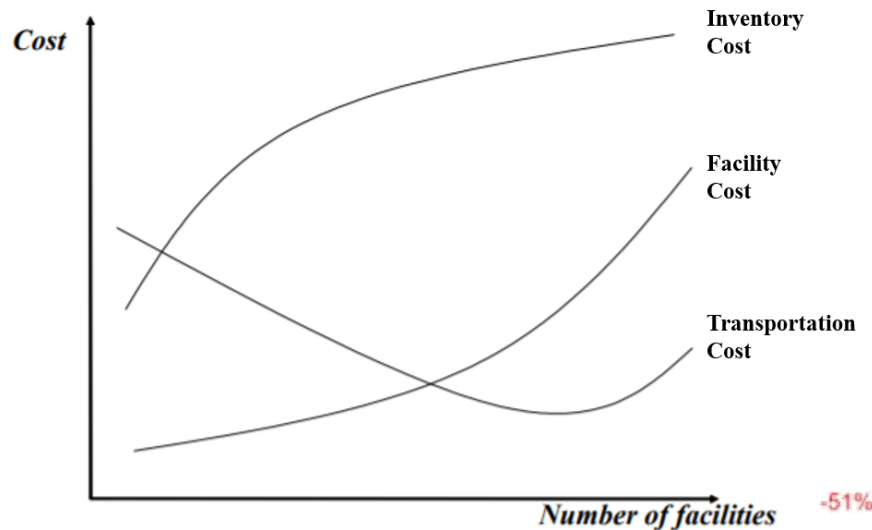
# Distribution + Warehousing

Level of Service drives warehouse location:

- 2-hour delivery window; Amazon DC in Garner, NC
- 1-hour delivery window; grocery DC in Durham + Goldsboro, NC



# Distribution + Warehousing



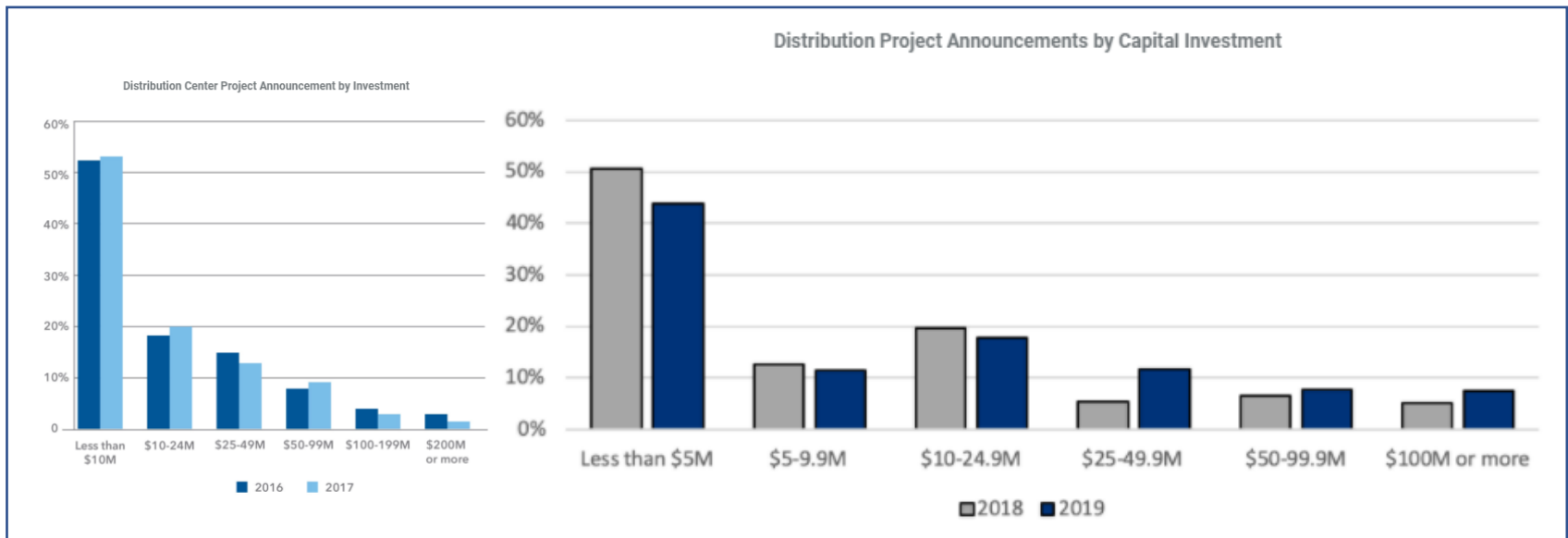
## % Change for Prologis Real Estate Sales (March 2020)



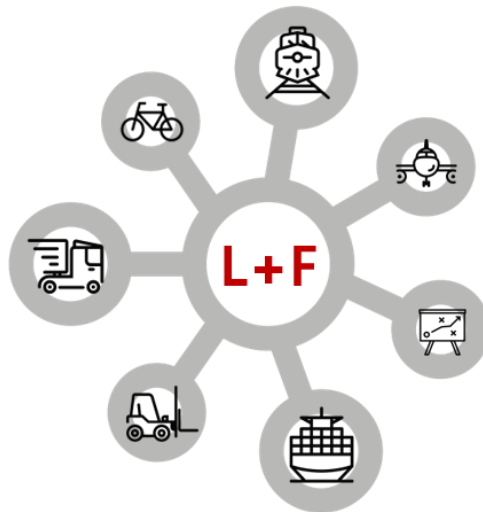
- 13.7B ft<sup>3</sup> of warehouse space was built between 2010 and 2016, with 65% built within the 10 largest US markets
- In 2016, eCommerce real estate purchases grew by 25% compared, to a 6% decline in brick and mortar purchases

# Distribution + Warehousing

- Smaller warehouses leading capital investment:







Transportation, Freight + Logistics:  
Know Your Mode

# Know Your Mode

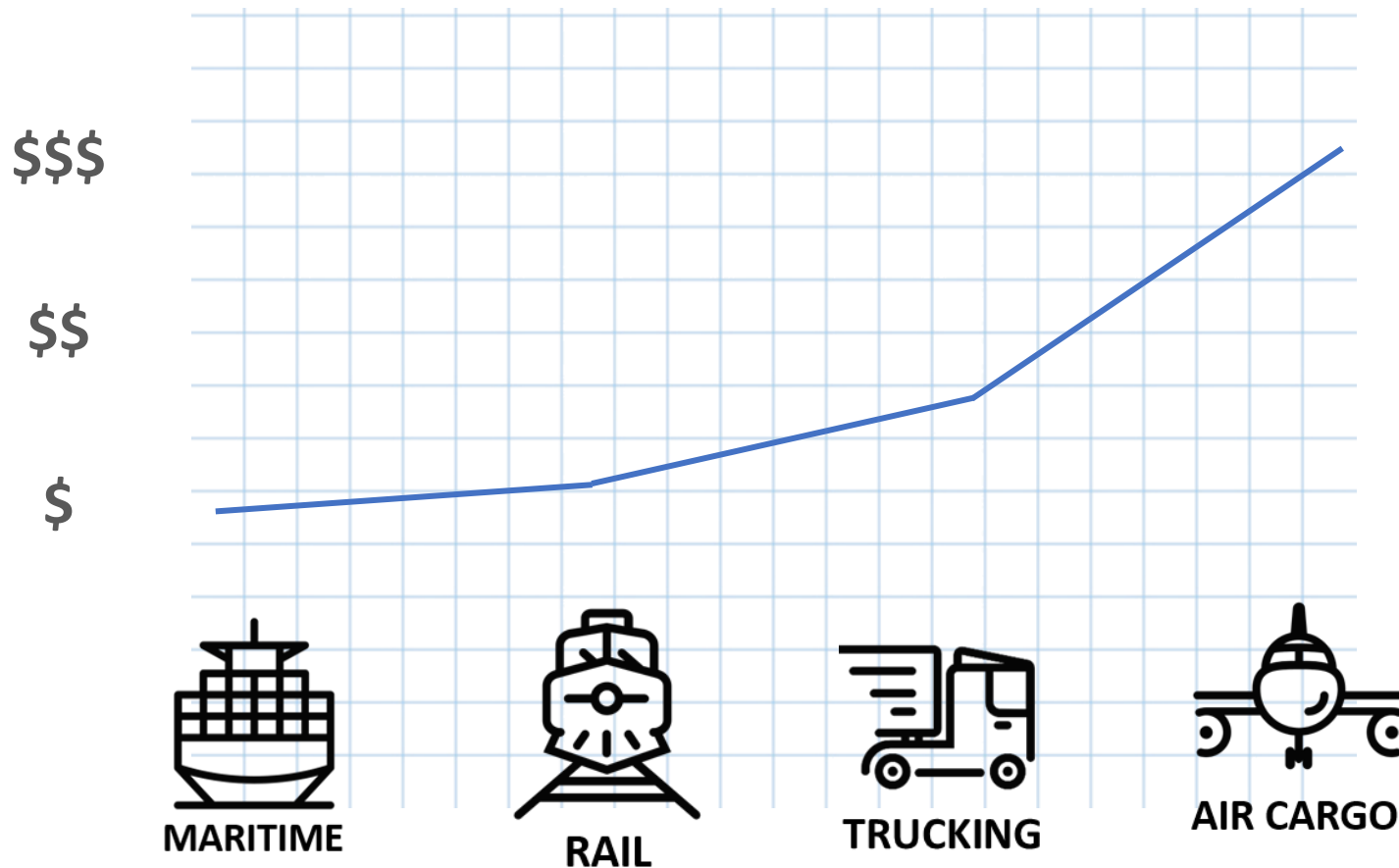


	Strengths	Weaknesses	Primary Role	Primary Product Characteristics
	Accessible Fast + Versatile Customer Service	Limited Capacity Volatile Costs	Smaller Shipments	High Value Finished Heavyweight Low Relative Volume
	High Capacity Low Cost	Accessibility Service Inconsistency	Larger Shipments Longer Distances	Low Value High Volume "Heat + Eat"
	Speed Freight Protection Flexibility International	Accessibility High Cost Low Capacity	Urgent Shipments	High Value Time Sensitive
	High Capacity Low Cost International	Slow Accessibility	Larger Shipments Longer Distances	Low Value Raw Materials Containerized



## Know Your Mode

## COST PER TON-MILE



# Total Logistics Costs

- In 2019, overall transportation costs grew by 2.5%
- U.S. logistics costs up nearly 12% (\$1.64T)
- 8% of 2018's \$20.5 trillion gross domestic product
- Highest cost as a segment of GDP since 2014
- Would additional investment in highway capital drive reduced costs?

## U.S. business logistics costs increased in 2018 (\$ billion)

TRANSPORTATION COSTS		2018	YoY 18/17	5 year CAGR
Full truckload		296.1	7.6%	3.6%
Less-than-truckload		71.8	8.3%	3.5%
Private or dedicated		300.9	13.1%	7.1%
Motor carriers		668.8	10.1%	5.1%
Parcel		104.9	8.7%	8.0%
Carload		61.4	7.2%	-0.6%
Intermodal		27.0	28.7%	8.1%
Rail		88.4	12.9%	1.6%
Air freight (includes domestic, import, export, cargo, and express)		76.5	9.2%	3.8%
Water and ports (includes domestic, import, and export)		45.7	12.8%	1.5%
Pipeline		53.0	12.7%	12.7%
Subtotal		1,037.4	10.4%	5.1%
Inventory carrying costs				
Storage		153.1		
Financial cost (WACC x total business inventory)		192.5		
Other (obsolescence, shrinkage, insurance, handling, others)		148.1		
Subtotal		493.7		
Other costs				
Carriers' support activities		52.3		
Shippers' administrative costs		52.1		
Subtotal		104.4		
Total US business logistics costs		1,635.46		

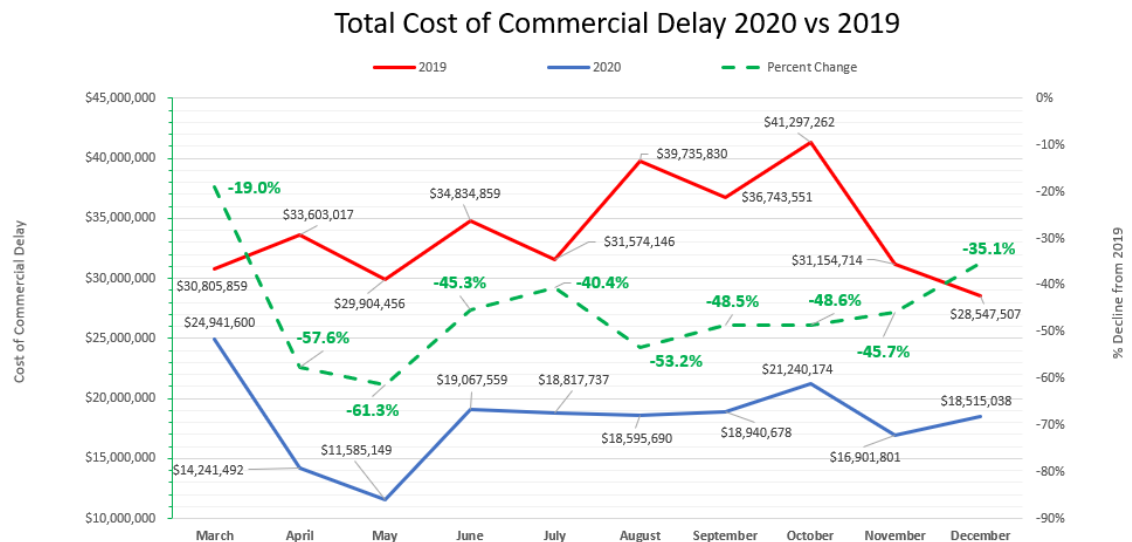
  

2018	YoY 18/17	5 year CAGR
296.1	7.6%	3.6%
71.8	8.3%	3.5%
300.9	13.1%	7.1%
668.8	10.1%	5.1%
104.9	8.7%	8.0%
61.4	7.2%	-0.6%
27.0	28.7%	8.1%
88.4	12.9%	1.6%
76.5	9.2%	3.8%
45.7	12.8%	1.5%
53.0	12.7%	12.7%
1,037.4	10.4%	5.1%
153.1	3.2%	3.0%
192.5	26.0%	3.0%
148.1	14.8%	3.0%
493.7	14.8%	3.0%
52.3	10.3%	4.5%
52.1	2.8%	5.3%
104.4	6.4%	4.9%
1,635.46	11.4%	4.4%

Note: YoY is year-on-year. WACC is weighted average cost of capital.  
Source: CSCMP's 30th Annual State of Logistics Report (see report Appendix)

# Highways + Trucking

- +86% of all freight tonnage in NC moved by trucks
- 7.7B road miles travelled by trucks in NC annually
- 62.7% of the tonnage and 61.9% of the value of all freight in US
- Primary mode for shipments moved less than 750 miles
- Issues include:
  - Congestion + bottlenecks
  - Truck parking
  - Workforce retention
  - Intermodal competition
  - Automation



# Highways + Trucking

- Cost of congestion to commercial enterprise:

Commercial congestion on the North Carolina Priority Freight Highway Network cost the North Carolina economy nearly **\$1.27B** in 2020

Performance Measure	% CHANGE (month to month)	Q3 Quarterly Summary	Quarterly % CHANGE Q2→Q3	Oct-20	% CHANGE (month to month)	Nov-20	% CHANGE (month to month)	Dec-20	% CHANGE (month to month)	Quarterly Summary	Quarterly % CHANGE	2020 Averages	2020 Totals
NCPFN System Total Commercial Cost of Delay (NPMRDS)	-0.1%	\$ 107,326,007	10.3%	\$ 115,959,200	8.1%	\$ 105,625,782	-8.9%	\$ 105,472,544	-0.1%	\$ 109,019,175	1.6%	\$ 106,458,992	\$ 1,277,507,899
NCPFN System Commercial Average Daily Cost per VMT (NPMRDS)	0.0%	\$ 0.25	8.8%	\$0.27	8.0%	\$0.26	-3.7%	\$0.25	-3.8%	\$ 0.26	5.4%	\$ 0.25	
NCPFN System Commercial Vehicle-hours of Delay (NPMRDS) (#Hours)	-0.1%	1068027	10.3%	1,153,938	8.1%	1,051,107	-8.9%	1,049,582	-0.1%	1,084,876	1.6%	1,059,399	12,712,785

# Highways + Trucking

## Types of Trucks

Dryvan

Flatbed

Tanker

Reefer

Intermodal

Box





# Highways + Trucking



FHWA Vehicle Classification	
5. Single Unit 2-Axle Trucks -2 axles, 6 tires (Dual rear tires), single unit	
6. Single Unit 3-Axle Trucks -3 axles, single unit	
7. Single Unit 4 or More Axle Trucks -4 or more axles, single unit	
8. Single-Trailer 3 or 4 Axle Trucks -3 or 4 axles, single trailer	
9. Single Trailer 5 Axle Trucks -5 axles, single trailer	
10. Single Trailer 6 or More Axle Trucks -6 or more axles, single trailer	
11. Multi-Trailer 5 or Less Axle Trucks -5 or less axles, multiple trailers	
12. Multi-Trailer 6 Axle Trucks -6 axles, multiple trailers	
13. Multi-Trailer 7 or More Axle Trucks -7 or more axles, multiple trailers	



# Highways + Trucking



- Full Truckload
- Partial Truckload
- Less-Than-Truckload

## Rail





# Rail



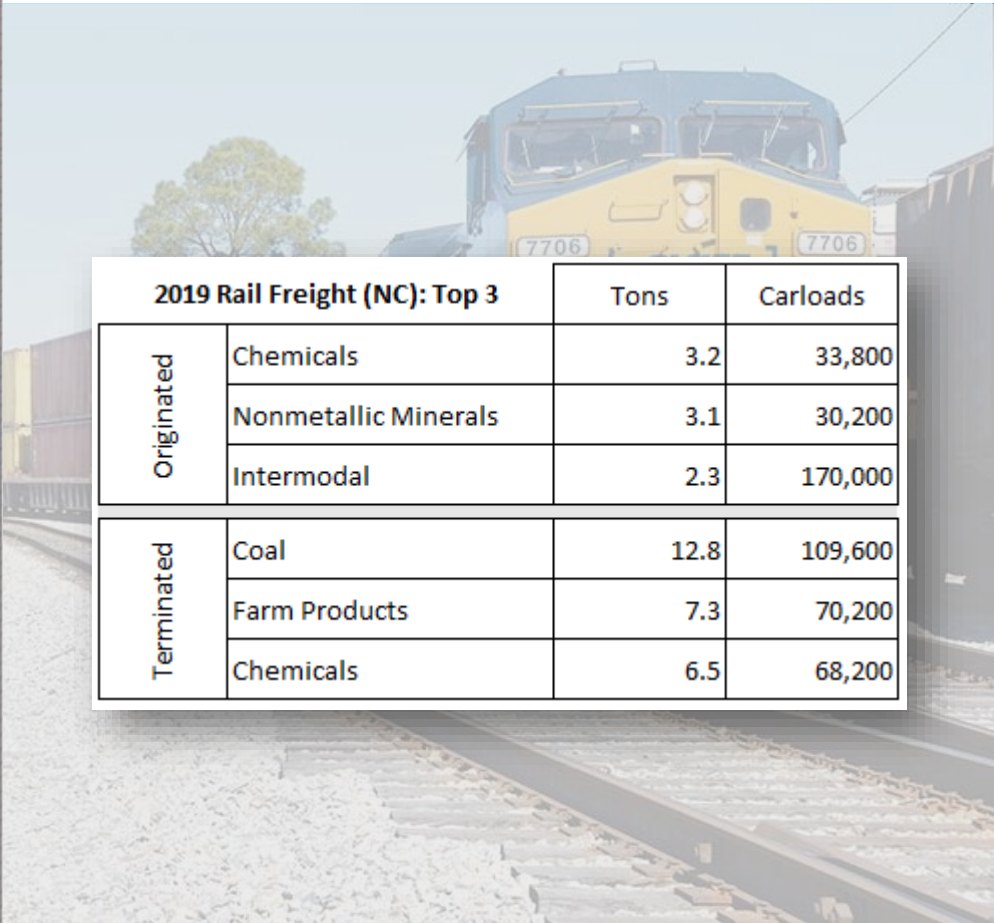
## Freight Rail:

- 2 Class I Railroads (NS + CSX)
- 20+ Short lines
- North Carolina Railroad (NCRR)
- 2,840+ miles of freight track in NC serving 86 of NC's 100 counties
- Bulk + breakbulk + intermodal
- Most commodities by tonnage, ton-miles from 1-2K miles
- Freight Originated (2019): 13.2M tons; 284,600 carloads
- Freight Terminated (2019): 45.2M tons; 592,600 carloads

# Rail

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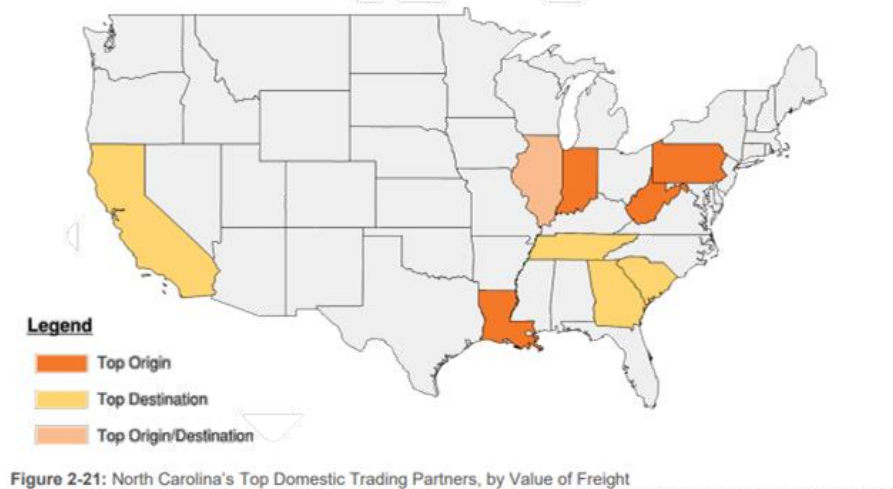
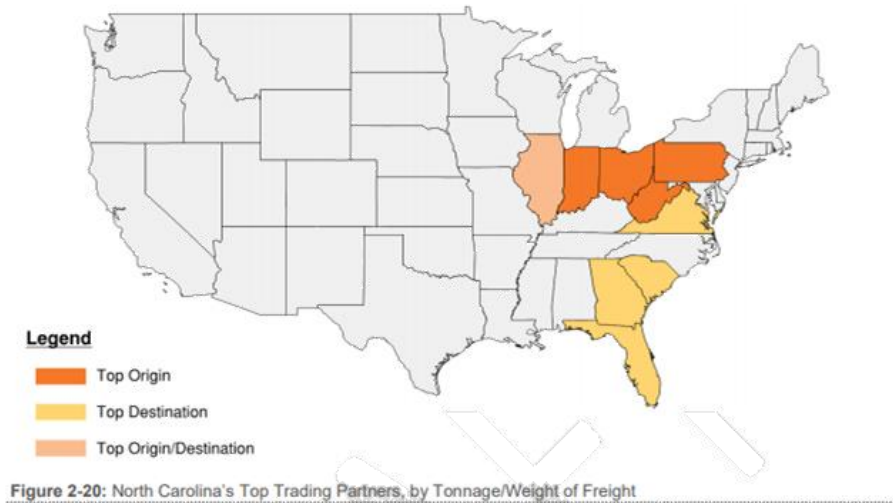
2019 Rail Freight (NC): Top 3		Tons	Carloads
Originated	Chemicals	3.2	33,800
	Nonmetallic Minerals	3.1	30,200
	Intermodal	2.3	170,000
Terminated	Coal	12.8	109,600
	Farm Products	7.3	70,200
	Chemicals	6.5	68,200



# Rail

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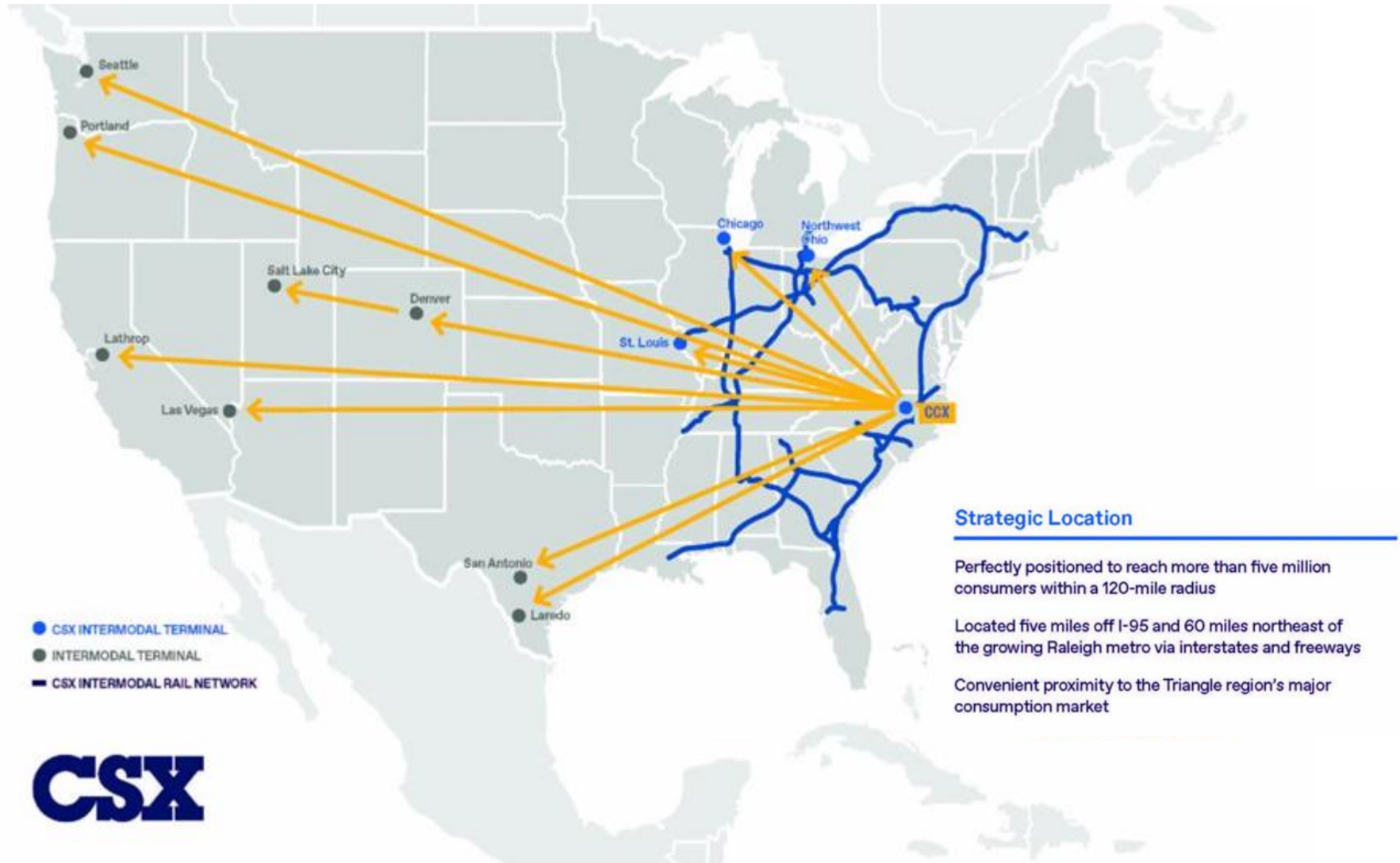
# Rail

## Passenger Rail:

- 8 daily trains serving 6 inter-city passenger routes with stops in 16 cities and towns
- 9 stops along the 174-mile Piedmont Corridor between Charlotte and Raleigh.
- +70% of NC population within a 30-mile radius of a passenger station
- \$80M federal grant to replace fleet: 6 new locomotives + 26 new railcars

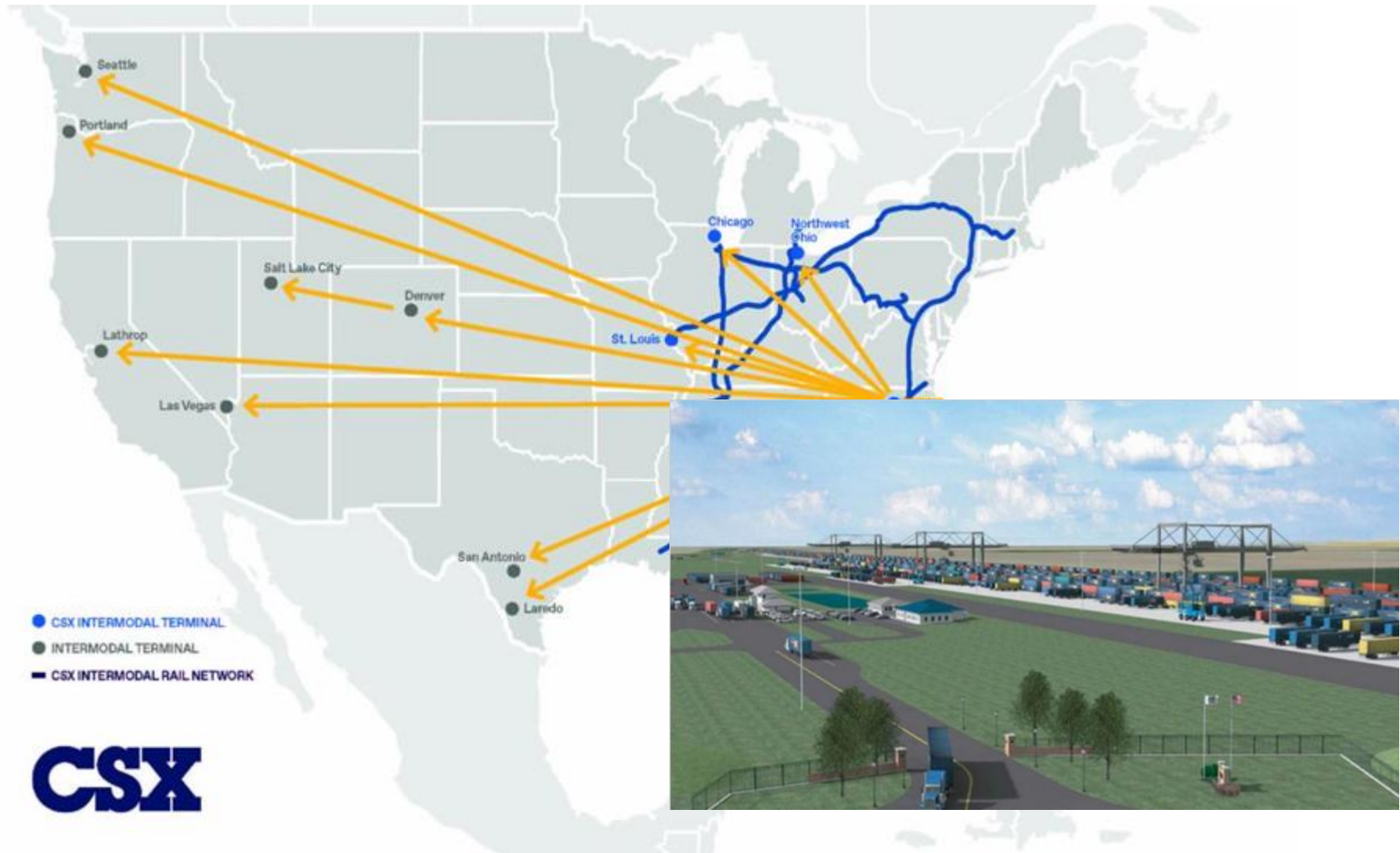


# Carolina Connector Update (CCX)





# Carolina Connector Update (CCX)







## Carolina Connector Update (CCX)





## Carolina Connector Update (CCX)



# Rail

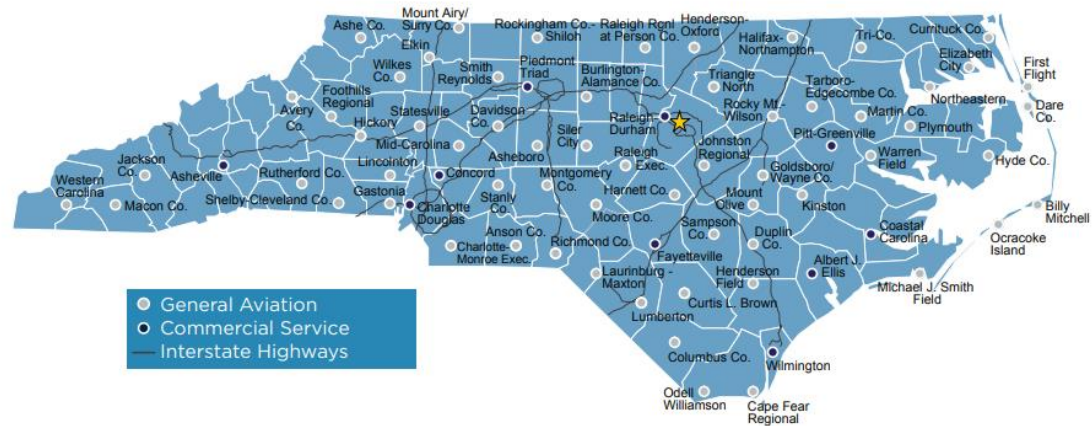
Rail programs for economic development:

- Rail Industrial Access Program uses state funds to help build or refurbish railroad tracks that a new or expanding industry needs.
- Freight Rail and Rail Crossing Safety Improvement program (FRRCSI)
- S-Line Grant to purchase S-line corridor for Southeast Corridor



# Aviation

- 72 Airports  
(10 Commercial + 62 GA)
- 94% of NC population lives within a 30-minute drive of a public airport
- Domestic Trading Partners:  
Tennessee, Kentucky, Indiana
- International Trading Partners:  
Germany, UK, France, Canada
- Inbound to NC: 488.3M lbs.
- Outbound from NC: 367.5M lbs.



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- Outbound from NC: 367.5M lbs.

Top Air Freight Origins (Domestic)	Top Air Freight Destinations (Domestic)	Top Air Freight Origins (International)	Top Air Freight Destinations (International)
North Carolina	North Carolina	Germany	Germany
Tennessee	Tennessee	United Kingdom	United Kingdom
Kentucky	Kentucky	France	France
Indiana	Indiana	Canada	Canada
Pennsylvania	Florida	Spain	Ireland
California	Pennsylvania	Italy	Spain
Florida	California	Ireland	Italy
Georgia	Virginia	Dominican Republic	Belgium
Virginia	New Jersey	Belgium	Dominican Republic
New Jersey	Illinois	Cape Verde	Australia

First  
Flight  
Dare  
Co.  
Co.  
Billy  
Mitchell  
oke



# Aviation

## Top benefits of air freight shipping

- Speed
- Reliability; flexibility
- Security; visibility
- Reduced inventory demand
- Meet customer deadlines

## Kinds of air cargo platforms:

- All cargo regular service, charter
- Passenger plane belly cargo
- Passenger to cargo conversions





## Aviation

Considerations for air freight:

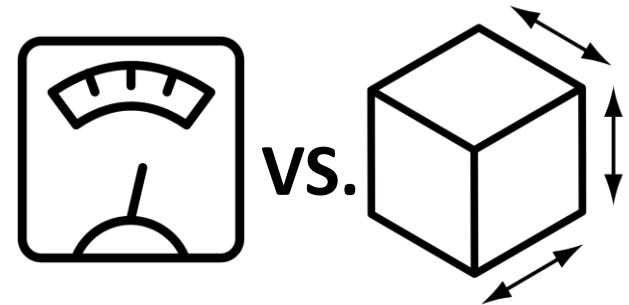
- Cargo weight versus volume (dims)
- Fuel surcharges; rapid customs entry

Domestic:

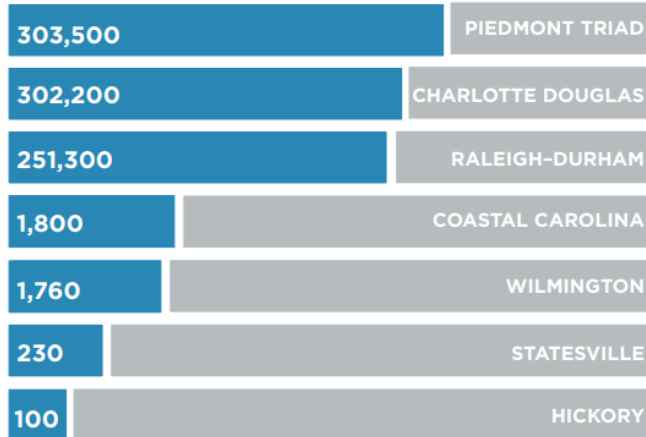
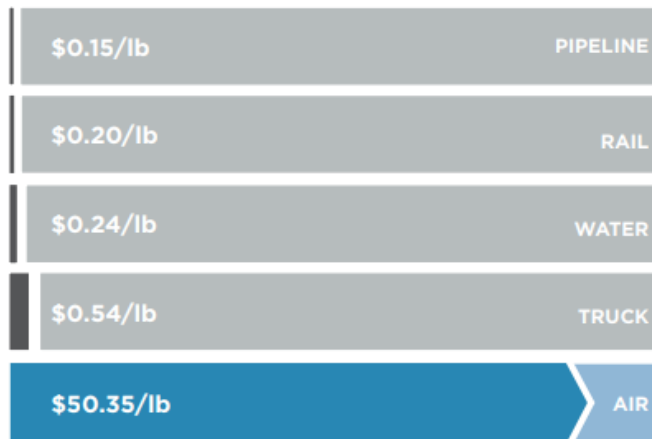
- Same-day air/next flight out
- Next-day air
- Second-day air
- Deferred air

International:

- Deferred service
- Express service

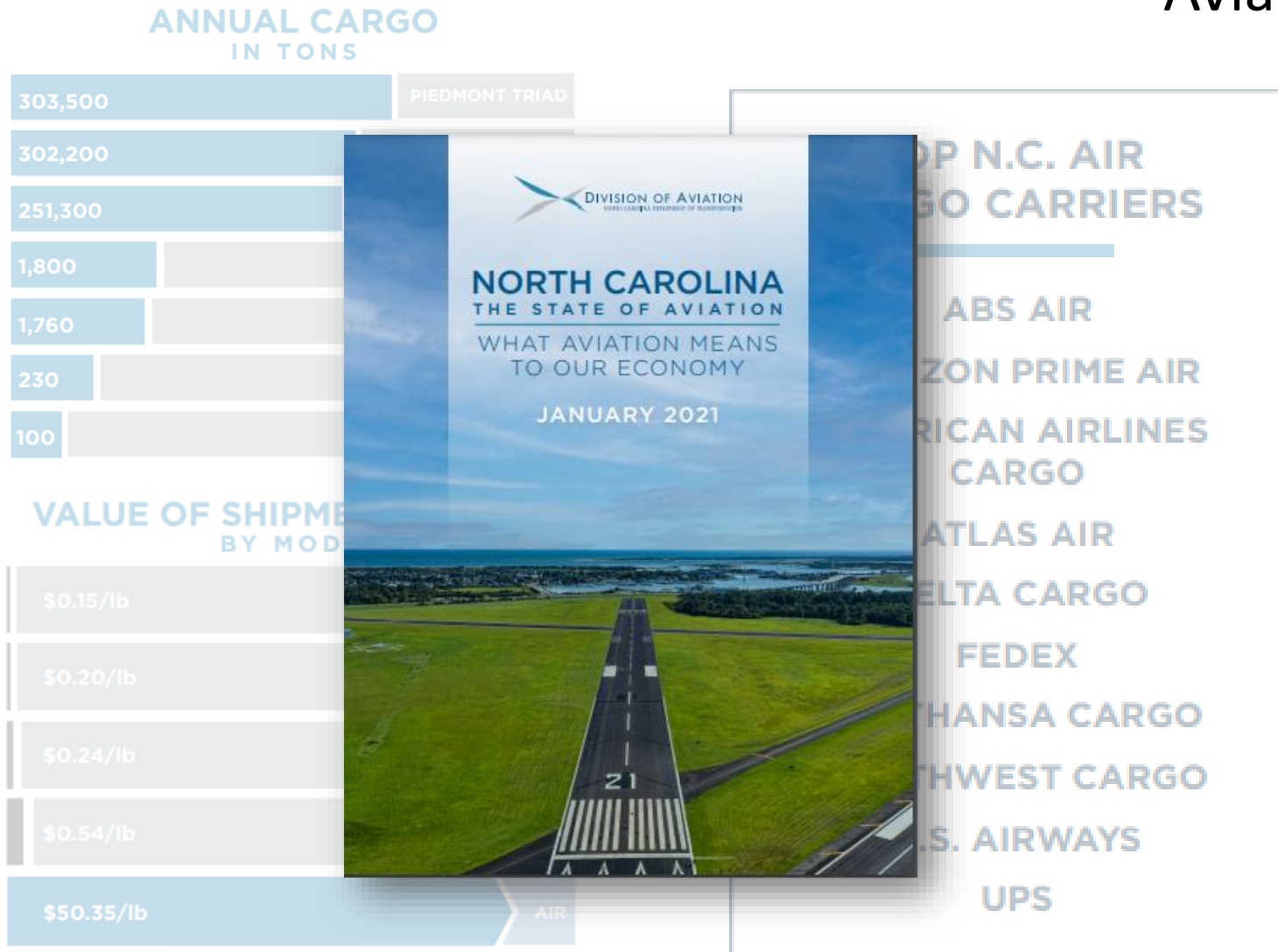


## Aviation

ANNUAL CARGO  
IN TONSVALUE OF SHIPMENT PER LB.  
BY MODETOP N.C. AIR  
CARGO CARRIERS

**ABS AIR**  
**AMAZON PRIME AIR**  
**AMERICAN AIRLINES CARGO**  
**ATLAS AIR**  
**DELTA CARGO**  
**FEDEX**  
**LUFTHANSA CARGO**  
**SOUTHWEST CARGO**  
**U.S. AIRWAYS**  
**UPS**

# Aviation



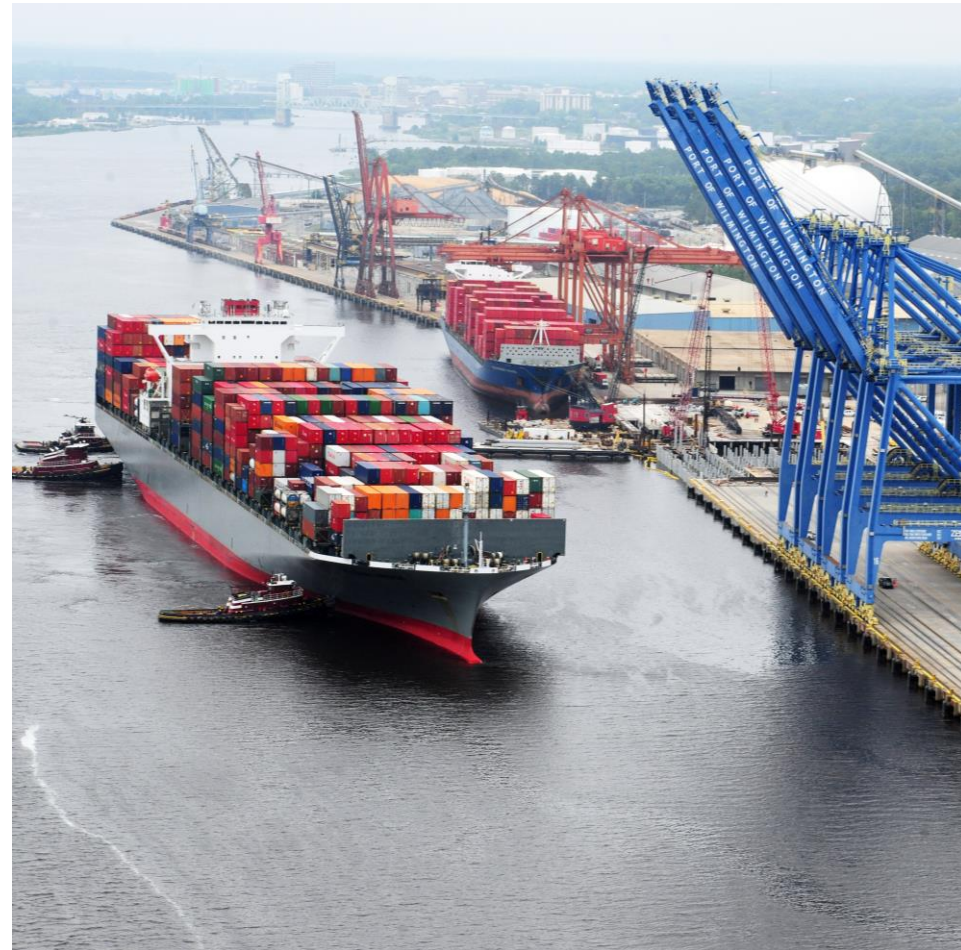
# Maritime

## Benefits of Maritime Shipping

- Heavy cargo; huge capacity
- Cost-effective
- Global network
- Environmental impacts
- Intermodal capabilities

## Drawbacks of Maritime Shipping

- Slower than other modes
- Fuel + security surcharges
- Inflexible schedules + routes
- Subject to delay
- Confusing/complicated pricing





# Maritime

## Kinds of Maritime Shipping

- Containerized
- Bulk, break-bulk
- Tanker
- Barge (bulk, container)
- RoRo
- Out-of-gauge; project cargo





# Maritime

## Port of Wilmington

- Container, bulk, breakbulk services
- 6 Post-Panamax cranes
- On-dock rail connecting to CSX network
- 5,000+ container gate moves per week
- 320,000+ TEU annual throughput
- 4 million+ tons of general cargo annually
- 1,000 ship calls per year
- Highest productivity on US East Coast
- FY20 container volume up 4% over FY19
- FY20 refrigerated container record:  
25,600 TEU, up 13% YOY



*The Port of Wilmington on the Cape Fear River*

# Maritime

## Port of Morehead City

- Bulk, breakbulk services
- 1M sq. ft. of covered storage
- Rail access to Norfolk Southern network
- RoRo access on terminal
- Heavy-duty gantry crane
- Rail + conveyor to shiploader for bulk
- 9 berths, over 5,300 ft. wharf frontage
- \$3.8B worth of goods move through annually



*The Port of Morehead City*



# Pipeline

Three primary classifications:

- Gathering pipelines
  - Smaller interconnected pipelines forming complex networks to bring crude oil or natural gas from wells to processing facility
- Transportation pipelines
  - Larger, long pipes moving products (oil, gas, refined products) between geos
- Distribution pipelines
  - Interconnected small diameter pipelines delivering product to final consumers (often industrial)



## Updated Agenda for Session 3

- Beyond Manufacturing: Agriculture, Energy, Finance
- North Carolina, Supply Chain Powerhouse:  
Organizations + Resources for Supply Chain Development
- eCommerce Revolution + The Post-COVID Marketplace
- The Future: Change Agents in the Supply Chain
- Sustainability Discussion



Questions?



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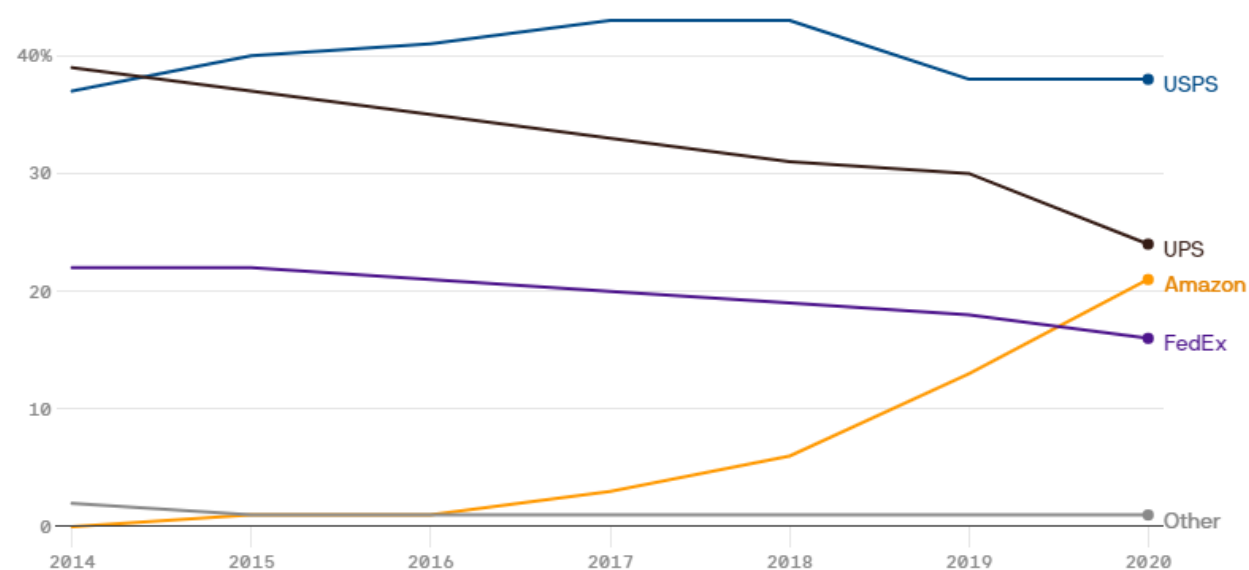
Homepage:  
[bit.ly/NCDOTsupplychain](http://bit.ly/NCDOTsupplychain)

NCDOT Connect Resources:  
[bit.ly/FreightConnectNC](http://bit.ly/FreightConnectNC)

USPS 38%  
UPS 24%  
Amazon 21%  
FedEx 16%  
Others 1%

## Market share of U.S. parcel volume

2014 to 2020



Reproduced from [Supply Chain Dive](#); Chart: Axios Visuals

