1. Introduction (Chapter 8)

1.1 Task Motivation and Objective

This section provides detailed summaries of key supply chains in Florida, covering all aspects of a product's lifecycle from raw materials, production facilities, to distribution and recycling. It examines each stage of a product's journey, including production, storage, transportation, and retail. These supply chains heavily rely on various modes of transportation within Florida's Strategic Intermodal System (SIS). Any disruption in these processes can significantly affect not just the supply chain but also Florida's economy and people. Therefore, it's crucial to have a clear understanding of these activities to inform the Florida Supply Chain Resiliency Strategic Plan.

This section analyzes the role, responsibility, and support the Florida SIS provides to the State's critical supply chains. Five critical supply chains were identified through the collection and analysis of data and in coordination with FDOT and key stakeholder input. These five critical supply chains contribute to key areas of the Florida economy and can be significantly impacted by natural or human-made disasters. These critical supply chains include the following industries:

1. Energy
2. Construction Materials
3. Agriculture
4. Food Manufacturing
5. Medical Devices

These summaries are comprised of six subsections, each of which develops comprehensive analyses for each Florida critical supply chain. The analysis approach to develop each of these subsections is presented below.

1.2 Analysis Approach

The summaries highlight the economic contribution of each critical supply chain to Florida economy, assess the market size and the dominant freight modes associated with each supply chain, and conduct a qualitative assessment of areas of risks particularly in regard to loss of transportation network and the potential impacts to Florida's SIS.

Supply Chain Economic Contribution

To determine the economic contribution of each supply chain, this analysis estimates employment levels, wages paid and value added associated with the supply chain in the analysis year 2022 using data from the Bureau of Labor Statistics (BLS) and Bureau of Economic Analysis (BEA). It also identifies main supply chain players using the January 2020 Dun & Bradstreet (D&B) database provided by Florida Department of Transportation (FDOT).

Supply Chain Market Analysis

The supply chain market analysis analyzes commodity flows and trading partners associated with the supply chain using FAF5.5.6 data in the analysis year 2022. The market analysis includes two main analyses:

- The directional flow analysis examines commodity tonnage and value by direction, including:
  - Intra flows: These flows originate and terminate within Florida. They encompass the transportation of goods produced and consumed entirely within Florida.
  - Inbound flows: These flows originate beyond Florida but terminate within Florida. They depict the extent to which Florida imports goods from other states and other countries.
  - Outbound flows: These flows originate within Florida, terminating beyond Florida. This reflects the level to which Florida is supplying (exporting) goods to other states and other countries.
- The top trading partners analysis identifies top domestic and internation trading partners for the supply chain.

These two types of analysis are critical in pinpointing the geographic coverage of the supply chain, the locations of key supply chain providers and end users within the State, and the potential impact that a disruption to any flow can have on the overall supply chain.

Supply Chain Dominant Freight Modes

The supply chain freight mode analysis identifies the modes used by the supply chain to transport their inputs and end products within Florida and outside of Florida and the dominant freight mode by directional flow associated with the supply chain. This analysis examines the tonnage and value (USD) of goods transported. The analysis uses data from FAF5.5.6 and USA Trade Online for the analysis year 2022 and the January 2020 D&B database provided by FDOT. The examined freight modes include:

- Truck: This mode includes private and for-hire trucks and excludes those involved in Multiple Modes and Mail or domestic air cargo.
- Rail: Common carrier or private railroad, excluding rail part of Multiple Modes and Mail.
- Water: Shallow draft, deep draft, Great Lakes, and intra-port shipments, excluding water part of Multiple Modes and Mail.
- Air (including truck-air): Shipments moved by air or truck-air combination, including air freight and air express. Domestic ground moves to/from ports categorized with Truck.
- Pipeline: Crude petroleum, natural gas, and product pipelines, excluding those part of Multiple Modes and Mail.
- Other mode includes:
  - Multiple Modes and Mail: Shipments by multiple modes and parcel delivery services, USPS, or couriers, capped at 150 pounds, excluding containerized or trailer-on-flatcar shipments.

- Other and Unknown: Miscellaneous movements, such as flyaway aircraft and shipments with undetermined mode.

The findings from this analysis shed light on the potential impacts that a disruption to any of these freight modes can have on the overall supply chain in Florida and help Florida stakeholders to strategize contingency plans to mitigate disruptions impacting the State's transportation network.

Initial Qualitative Assessment of Areas of Risk

This section Identifies disrupter events and areas of risk for each supply chain. It analyzes how these disrupter events impact Florida's SIS infrastructure supporting the supply chains, particularly in regard to loss of transportation network and supply chain reliability. It should be noted that this is an initial qualitative assessment of areas of risk for each of the critical supply chains and the full supply chain risk analysis will be conducted as part of Task 6.

1.3 Data Sources

This section discusses the data sources used in this analysis.

Freight Analysis Framework (FAF) - The U.S. Department of Transportation's (U.S. DOT) publishes FAF as its primary data source for understanding commodity flows. Drawing from the Commodity Flow Survey (CFS), foreign trade data, and various other freight sources, FAF offers comprehensive insights into the movement of goods among states and metropolitan areas across all transportation modes. This dataset encompasses freight flows in terms of weight, value, and activity, providing forecasts categorized by freight mode, commodity type, and trade classification (import, export, and domestic). The U.S. Standard Classification of Transported Goods (SCTG) is used in FAF for commodity classification. Updated every five years, the latest iteration, FAF5.6, was released in April 2024. FAF5.6 has information on import and export commodity flows with tonnage (in thousand tons) and value (in million dollars) by transportation mode and origin-destination pairs. The year of 2022 was obtained for this study for commodity flow analysis.

USA trade online - USA Trade Online is a comprehensive trade data from the U.S. Census Bureau which offers U.S. merchandise trade statistics. The data provides detailed trade information on the state of origin (export) and destination (import) for all 50 states and other regions such as the District of Columbia, Puerto Rico, etc. This includes information on the country of origin and destination for all commodities, categorized by industry classification schemes such as the three- and four-digit North American Industry Classification System (NAICS) levels. The data covers the value and shipping weight of goods, along with the method of transportation (air, vessel, and containerized vessel). In addition, it provides access to monthly, annual, and year-to-date cumulative data starting from 2008 which allows for comprehensive analysis of trade flows and trends. For analysis of foreign trade, because FAF5 only offers forecasted trade data for 2022 in aggregated zones without specifics, data from USA Trade Online for 2022 is sourced and analyzed to ensure accuracy.

The Bureau of Economic Analysis (BEA) Make-Use Tables - The BEA employs Make-Use tables as a critical tool for understanding the interrelationships within an economy. These tables provide a comprehensive snapshot of how different sectors and industries interact through production and consumption. Make-Use tables illustrate the flows of goods and services from their production (make) to their ultimate consumption (use). By mapping

out these connections, BEA Make-Use tables allow to quantify the inputs and outputs of various sectors, assess dependencies between industries, and track the ripple effects of changes in one sector on others. This comprehensive view aids policymakers, businesses, and researchers in making informed decisions about resource allocation, economic planning, and policy formulation. Since the state Make-Use tables are not publicly available, this analysis utilizes the national Make-Use tables available through BEA website. Due to a relatively mature U.S. economy structure over time, the 2017 U.S. BEA Make-Use tables are used in this study to understand the inputs and outputs for each critical supply chain.

Dun & Bradstreet (D&B) database - Dun & Bradstreet (D&B) is a well known provider of commercial data. Their database on business establishments include information on various companies, ranging from small to large. This business establishment database includes business coordinates (latitude/longitude), NAICS associated with the business, and business size (number of employees or employee ranges).[1]

Inland Flooding - The floodplain data is collected from University of Florida GeoPlan Center – Florida Geographic Data Library (FGDL)[2]. FGDL shows flood hazard zones for the 1 percent annual chance return event (100-year floodplain), the 0.2 percent annual chance return event (500-year floodplain, and areas of undetermined (minimal) flood risk.

Storm Surge (Tropical Cyclone) – The storm surge data is obtained from the Florida Sea Level Scenario Sketch Planning Tool which is also developed by UF Geoplan Center. Storm surge zones are based on Category 1, 2, 3, 4, and 5 hurricanes.[3]

Sea Level Rise (1-foot, 2-foot, 3-foot, and 5-foot SLR) -The Seal Level Rise Viewer of National Oceanic and Atmospheric (NOAA) shows the sea level rise and potential coastal flooding impact areas and relative depth.[4]

Wildfire Ignition Density - Southern Group of State Foresters (SGSF) Wildfire Risk Assessment Portal (SouthWRAP) provides information on wildfire risk levels for 13 southern states in the USA.[5]

Severe Thunderstorm - Federal Emergency Management Agency (FEMA) National Risk Index (NRI) is a dataset and online tool that illustrates US communities most at risk for 18 natural hazards including severe thunderstorm (strong wind and lighting risk).[6]

Sinkhole Occurrences - Florida Department of Environmental Protection (FDEP) contracted Geological Survey (FGS) to map the favorability of sinkhole occurrence based on the state's geology.[7]

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[1] Dun & Bradstreet (D&B), Last Updated April 30, 2024. Dun & Bradstreet: Leading Business Data Analytics (dnb.com)
[2] University of Florida GeoPlan Center, Last Updated April 30, 2024. University of Florida GeoPlan Center – Geo-Facilities Planning and Information Research Center (ufl.edu)
[3] Sea Level Scenario Sketch Planning Tool Last, Updated April 30, 2024. Sea Level Scenario Sketch Planning Tool – Just another GeoPlan Center WP Sites site (ufl.edu)
[4] National Oceanic and Atmospheric (NOAA) Sea Level Rise Projections, Last Updated April 30, 2024. Sea Level Rise and Coastal Flooding Impacts (noaa.gov)
[5] Southern Group of State Foresters (SGSF) Wildfire Risk Assessment Portal (SouthWRAP), Last Updated April 30, 2024. SGSF WRAP - Home (southernwildfirerisk.com)
[6] FEMA National Risk Index, Last Updated April 30, 2024. Learn More | National Risk Index (fema.gov)
[7] Florida Department of Environmental Protection (FDEP), Last Updated April 30, 2024. Florida Department of Environmental Protection Geospatial Open Data (state.fl.us)

Extreme Heat - The Localized Constructed Analogs (LOCA) data set uses statistical techniques to correct global climate model data for biases and downscale those data to a 1/16th degree spatial resolution. Change in Days above 95 Degrees Fahrenheit (RCP 4.5) data was obtained from LOCA Data Viewer.[8]

2. Energy Supply Chain

2.1 Supply Chain Economic Contribution

Florida's energy supply chain powers the state through the generation of electricity and moves the state by providing a mix of fuel for cargo shipments. Florida is the second largest producer of electricity in the nation. In 2022, natural gas fueled about 74 percent of Florida's total electricity generation, with nuclear electric power providing about 12 percent, and renewable resources and coal suppling the remaining 14 percent.[9] This electricity serves a variety of customers, with 50 percent consumed by residential customers (Figure 1).

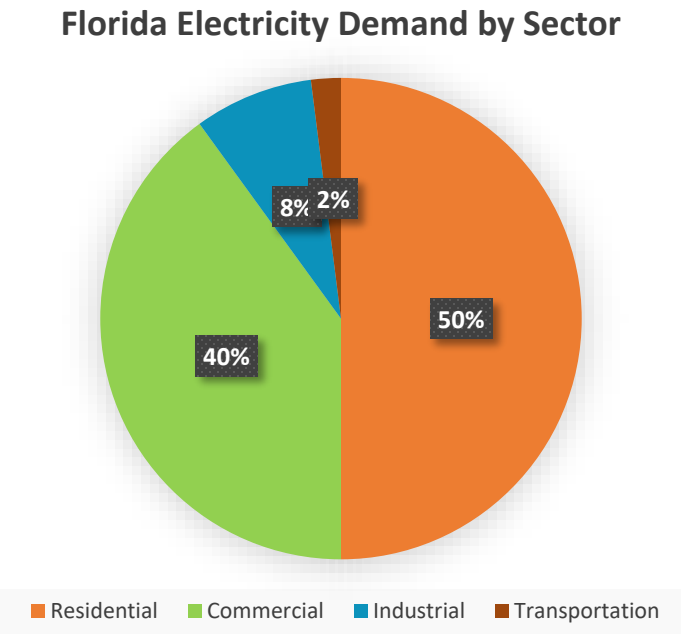
Florida attracts large numbers of out-of-state visitors every year. In 2023 Florida welcomed approximately 135 million visitors.[10] Florida's large population combined with the large number of visitors helps make the state the third-highest motor gasoline consumer and the second-highest jet fuel user in the nation. [11] The transportation sector is the largest consumer of fuel (40%), followed by the residential sector (30%) (Figure 2).

The energy supply chain encompasses the entire process from extracting resources to delivering usable energy to end-users[12], comprising three key components:

- Energy supply, which involves upstream refinery processes to extract and process energy resources.
- Energy transformation, which includes the transmission and distribution (T&D) of energy, converting raw energy into usable forms.
- Energy demand covers energy consumption in various sectors, including households, industrial activity, logistics and transportation, and commercial activity.

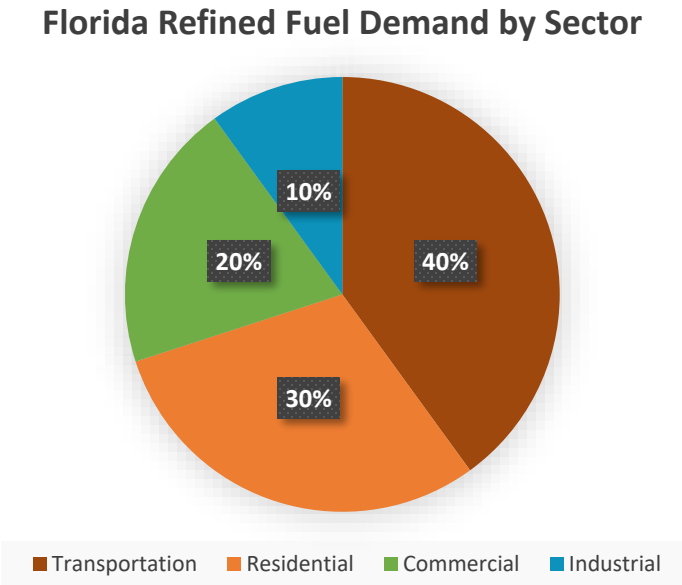
FIGURE 1. FLORIDA ENERGY SUPPLY CHAIN – FLORIDA ELECTRICITY DEMAND BY SECTOR IN THE STATE

[8] Localized Constructed Analogs (LOCA) Data Viewer, Last Updated April 30, 2024. scenarios.globalchange.gov/loca-viewer/
[9] U.S. Energy Information Administration (EIA). Florida State Energy Profile. Last Updated February 15, 2024. Florida Profile (eia.gov)
[10] VISIT FLORIDA. Research (visitflorida.org)
[11] U.S. Energy Information Administration (EIA). Florida State Energy Profile. Last Updated February 15, 2024. Florida Profile (eia.gov)
[12] Bhattacharyya, Subhes C. *Energy economics: concepts, issues, markets and governance*. Springer Nature, 2019.



Source: U.S. Energy Information Administration (EIA). Florida State Energy Profile.

FIGURE 2. FLORIDA ENERGY SUPPLY CHAIN – FLORIDA REFINED FUEL DEMAND BY SECTOR IN THE STATE



Source: U.S. Energy Information Administration (EIA). Florida State Energy Profile.

Florida does not have significant reserves of petroleum and natural gas, and does not have any coal reserves[13]; therefore, this analysis focuses on the last two components of the supply chain, i.e., the energy transformation and the energy demand. As shown in **Table 1,** energy transformation includes all the industries associated with electric power generation, transmission, and distribution while energy demand comprises the distribution of refined fuels.

TABLE 1.LIST OF INDUSTRIES COMPRISING THE ENERGY SUPPLY CHAIN IN FLORIDA

Electricity Manufacturing Industries	Refined Fuel Supplier Industries
• Hydroelectric power generation • Fossil fuel electric power generation • Nuclear electric power generation • Solar electric power generation • Wind electric power generation • Geothermal electric power generation • Biomass electric power generation • Other electric power generation • Electric bulk power transmission and control • Electric power distribution • Natural gas distribution	• Petroleum bulk stations and terminals • Petroleum and petroleum products merchant wholesalers • Gasoline stations and fuel dealers

Source: Cambridge Systematics Analysis based on information provided by the U.S. BEA Make-Use Tables.

Table 2 shows the electricity manufacturing and refined fuel supply chain contributions to Florida's economy in 2022. The energy supply chain not only supports Florida's resiliency by ensuring uninterrupted power, cooling, and other essential services during disruptions, it also contributes to Florida's economic growth. In 2022, this supply chain added approximately $20 billion to Florida's GSP, an increase of 6 percent compared to 2017, and supported more than 75 thousand direct jobs that generated around $4.8 billion in wages. Overall, this supply chain contributed 0.8 percent to both job creation and statewide wages, and 1.4 percent to Florida GSP.

TABLE 2. CONTRIBUTION OF THE ENERGY SUPPLY CHAIN TO FLORIDA ECONOMY IN 2022

Industry	Employment (jobs)	Wages (Millions of USD)	GSP (Millions of USD)
Electric power generation, transmission and distribution (NAICS 2211)	21,929	$2,629	$19,554
Natural gas distribution (NAICS 2212)	1,911	$187	$816
Petroleum and petroleum products merchant wholesalers (NAICS 4247)	3,655	$386	$64
Gasoline stations and fuel dealers (NAICS 457)	48,229	$1,591	$305
Total Energy Supply Chain	75,724	$4,794	$20,739

[13] U.S. EIA, Florida State Energy Profile, 2018-23. https://www.eia.gov/state/analysis.php?sid=FL

Industry	Employment (jobs)	Wages (Millions of USD)	GSP (Millions of USD)
Florida	9,358,228	$596,788	$1,439,065
Supply Chain Share (%)	0.8%	0.8%	1.4%

Source: Cambridge Systematics Analysis using data from BLS and BEA 2022. U.S. Bureau of Labor Statistics. Quarterly Census of Employment and Wages (QCEW). NAICS-Based Data Files https://www.bls.gov/cew/downloadable-data-files.htm

Notes: Employment (jobs) corresponds to the annual average of monthly employment levels. Employment wages is the sum of the four quarterly total wage levels in a year. GDP is the total market value of the final goods and services produced by the industry within Florida.

Electricity Generation

During 2022, utility companies associated with electricity generation added more than $20 billion (or 1.5 percent) to Florida's GSP. Direct employment in both, the electric power generation, transmission and distribution sector, as well as natural gas distribution in the State paid $2.8 billion in total annual wages to around 23,840 employees in 2022. **Table 3** lists the top five electricity and natural gas companies in Florida based on employment. The top five electric and natural gas companies account for nearly 30 percent and 51 percent, respectively, of the total employment they create in the State.

TABLE 3. TOP ELECTRICITY AND NATURAL GAS RETAILERS IN FLORIDA BASED ON EMPLOYMENT IN 2020

Top Electricity Companies	Total Jobs	Share (%)
Florida Power & Light Company	1,876	10%
Jacksonville Electric Authority - JEA	1,218	6%
Seminole Electric Cooperative Inc.	851	4%
Orlando Utilities Commission	801	4%
Tampa Electric Company	710	4%
Top five Electricity Company	**5,456**	**29%**
All Electricity Companies in Florida	**18,923**	**71%**
Top Natural Gas Companies	**Total Jobs**	**Share (%)**
Okaloosa Gas District	137	16%
Teco Energy Inc.	114	13%
Igas USA Inc.	75	9%
Florida Gas Transmission Company LLC	68	8%
Centerpoint Energy Houston Electric LLC	54	6%
Top five Natural Gas Company	**448**	**51%**
All Natural Gas Companies in Florida	**875**	**49%**
Combined to Electric and Natural Gas Companies	**Total**	
Top five electricity and natural gas companies	**5,904**	

Source: Cambridge Systematics Analysis using data from D&B Database (Jan 2020).

Note: The total number of jobs in this table corresponds to January 2020 while the number of jobs in **Table 2** corresponds to jobs in year 2022.

Refined Fuel Distribution

Florida does not have any crude oil refineries, nor does it have coal reserves or production. The State relies on refined petroleum and coal products imported from several states and overseas to meet its needs.[14] Because Florida is a major tourist destination, jet fuel is of significant importance. Gas stations, fuel dealers, and jet fuel merchant wholesalers represent the most important industries for the energy demand component of the energy supply chain. In 2022, these industries generated around 52,000 direct jobs, $2 billion in wages and added $369 million to Florida's GSP, which constitutes 0.026 percent of the State's GDP. Florida's top fuel distribution companies, based on employment and number of business locations in the State, are shown in **Table 4**. The top five refined petroleum and petroleum products merchant wholesalers generate 14 percent of the total direct jobs in the State.

TABLE 4. TOP REFINED FUEL DISTRIBUTION COMPANIES IN FLORIDA IN 2020

Top Refined Petroleum and Petroleum Products Merchant Wholesalers	Total Jobs
First Coast Energy L.L.P.	152
Banyan Air Services Inc.	131
Transmontaigne Product Services LLC	80
Port Consolidated Inc.	12
Tropic Oil Company LLC	62
Top Largest Gas Stations	**Number of Business Locations**
Exxon Mobil	994
Circle K	949
Shell	672
Chevron	588
BP	368

Source: Cambridge Systematics Analysis using data from D&B Database (Jan 2020) for employment and ScrapeHero (2024) for number of locations.

Note: The total number of jobs in this table corresponds to January 2020 while the number of jobs in **Table 2** corresponds to jobs in year 2022.

2.2 Supply Chain Market Analysis

Commodity Flow Analysis

Table 5 presents the directional flows for the energy supply chain in 2022**.** Florida is the second largest producer of electricity in the nation, and ranks third nationwide in energy consumption.[15] This helps explain why the highest share of commodity flows represent intrastate movements – 61 percent of total tonnage and 68 precent of total value in 2022. Inbound movements make up almost all of the remaining commodity flows given Florida

[14] U.S. EIA, Florida State Energy Profile, 2018-23. https://www.eia.gov/state/analysis.php?sid=FL.

[15] U.S. EIA, Florida State Energy Profile, 2018-23. https://www.eia.gov/state/analysis.php?sid=FL

relies on energy from other states and overseas – 37 percent of total tonnage and 30 precent of total value in 2022.

TABLE 5. FLORIDA ENERGY SUPPLY CHAIN - DIRECTIONAL COMMODITY FLOWS BY TONNAGE AND VALUE IN 2022

Directional	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Intra	97,614	61%	$40,629	68%
Inbound	59,090	37%	$18,409	30%
Outbound	2,243	1%	$1,381	2%
Total	**158,948**	**100%**	**$60,419**	**100%**

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

Table 6 presents Florida imports and exports and total trade for the energy supply chain, including the breakdown between domestic and international trade. Total energy imports represent 98 percent and 94 percent of total trade based on tonnage and value (USD), respectively, with the domestic partners contributing 88 percent of the total import tonnage and 78 percent of the total import value (USD). Total energy exports account for a small share of 2 percent and 6 percent of total trade based on tonnage and value (USD), respectively. Florida depends primarily on domestic imports to meet its demand for energy.

TABLE 6. FLORIDA ENERGY SUPPLY CHAIN – DOMESTIC AND INTERNATIONAL TRADE IN 2022

Trade	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Domestic Exports	724	1%	$894	5%
International Exports	387	1%	$213	1%
Total Exports (E)	**1,111**	**2%**	**$1,107**	**6%**
Domestic Imports	57,395	88%	$17,044	87%
International Imports	6,802	10%	$1,436	7%
Total Imports (I)	**64,196**	**98%**	**$18,480**	**94%**
Total Trade = (E) + (I)	**65,307**	**100%**	**$19,587**	**100%**

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Notes: Commodity flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19). Florida domestic exports correspond to *domestic flows* from Florida to domestic destinations. Florida domestic imports correspond to *domestic flows* from domestic origins to Florida. Florida international exports are *foreign trade flows* that originate in Florida and terminate in other countries. Florida international imports are *foreign trade flows* that originate in other countries and terminate in Florida.

Top Domestic Trading Partners

Table 7 shows Florida's top 10 domestic trading partners by tonnage. Florida export tonnage from the top 10 domestic partners accounts for 80 percent of total domestic exports. Among the top 5 domestic exporters are Geogia, Pennsylvania, California, Virginia, and Alabama. Florida import tonnage from the top 10 domestic partners accounts for 100 percent of total domestic imports. Among the top 5 domestic importers are Alabama, Louisiana, Mississippi, Georgia, and Texas.

Table 8 shows Florida's top 10 domestic trading partners by value. The top trading states by value are similar to that by tonnage although the rankings are slightly different. Florida export value (USD) from the top 10 domestic partners accounts for 79 percent of total domestic exports. Among the top 5 domestic exporters are Geogia, California, Pennsylvania, Virginia, and Texas. Florida import value (USD) from the top 10 domestic partners accounts for 99 percent of total domestic imports. Among the top 5 domestic importers are Louisiana, Alabama, Mississippi, Texas, and Georgia.

Alabama, Louisiana, Mississippi, Georgia and Texas play significant role in Florida's energy supply chain by supplying the state with refined fuel products such as gasoline, diesel and jet fuel. Relying on a select number of states suggests potential vulnerabilities in Florida's energy supply chain should there be a disruption, especially given Florida' near total reliance on out of state providers for energy products.

TABLE 7. FLORIDA ENERGY SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY TONNAGE IN 2022

State	Export (Thousand Tons)	State	Import (Thousand Tons)
Georgia	110	Alabama	33,691
Pennsylvania	72	Louisiana	10,661
California	65	Mississippi	5,235
Virginia	56	Georgia	3,929
Alabama	51	Texas	2,176
New Jersey	51	Iowa	560
Texas	50	Illinois	456
North Carolina	46	Indiana	209
Ohio	42	New Jersey	192
Mississippi	33	Nebraska	83
Top 10 (Tonnage)	*576*	*Top 10 (Tonnage)*	*57,192*
Top 10 (Percentage)	*80%*	*Top 10 (Percentage)*	*100%*
Total	724	Total	57,395

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity trade flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

TABLE 8. FLORIDA ENERGY SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY VALUE IN 2022

State	Export (Million USD)	State	Import (Million USD)
Georgia	$157	Alabama	$5,698

State	Export (Million USD)	State	Import (Million USD)
California	$98	Louisiana	$5,609
Pennsylvania	$76	Mississippi	$2,493
Virginia	$73	Texas	$1,284
Texas	$71	Georgia	$855
North Carolina	$67	Iowa	$279
Ohio	$57	New Jersey	$249
Mississippi	$46	Illinois	$207
Alabama	$34	Indiana	$106
Tennessee	$23	North Dakota	$37
Top 10 (Million USD)	*$702*	*Top 10 (Million USD)*	*$16,817*
Top 10 (Percentage)	*79%*	*Top 10 (Percentage)*	*99%*
Total	$894	Total	$17,044

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity trade flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

Top Foreign Trading Partners

Table 9 shows Florida's top foreign trading partners for imports and exports in 2022. The USA Trade Online database offers limited information on export and import trading partners for the energy supply chain in Florida, so this analysis uses FAF data and its Foreign Trading Regions to identify Florida's international trading partners.

Florida international imports of energy products totaled 6,802 thousand tons and $1,436 million in 2022. Based on tonnage, the top three import regions were Europe, Rest of Americas, and Mexico. Florida imported 5,224 thousand tons (or 77 percent of total imported tonnage) from these three regions in 2022. Based on value, the top three import regions are Europe, Rest of Americas, and SW & Central Asia. Florida imported $1,006 million (or 71 percent of total imported value) these three regions in 2022.

Florida international exports of energy products totaled 387 thousand tons and $213 million in 2022. Florida has Rest of Americas, Mexico, and Canada as the top three trading partners by both tonnage and value. Florida exported 363 thousand tons (or 94 percent of total tonnage) and $204 million (or 96 percent of total exported value) to these three regions in 2022.

TABLE 9. FLORIDA ENERGY SUPPLY CHAIN – FOREIGN TRADING REGIONS BY TONNAGE AND VALUE IN 2022

Foreign Trading Regions	Import		FAF Foreign Trading Zones	Export	
	Tonnage (Thousand Tons)	Value (Million USD)		Tonnage (Thousand Tons)	Value (Million USD)
Rest of Americas	2,534	$581	Rest of Americas	265	$183
Europe	1,886	$363	Mexico	63	$13
Mexico	804	$73	Canada	35	$8

Foreign Trading Regions	Import		FAF Foreign Trading Zones	Export	
	Tonnage (Thousand Tons)	Value (Million USD)		Tonnage (Thousand Tons)	Value (Million USD)
SW & Central Asia	583	$182	Africa	10	$4
Africa	562	$62	Europe	5	$2
Canada	335	$135	SE Asia & Oceania	3	$2
Eastern Asia	95	$38	SW & Central Asia	3	$1
SE Asia & Oceania	3	$2	Eastern Asia	2	$1
Total	6,802	$1,436	Total	387	$213

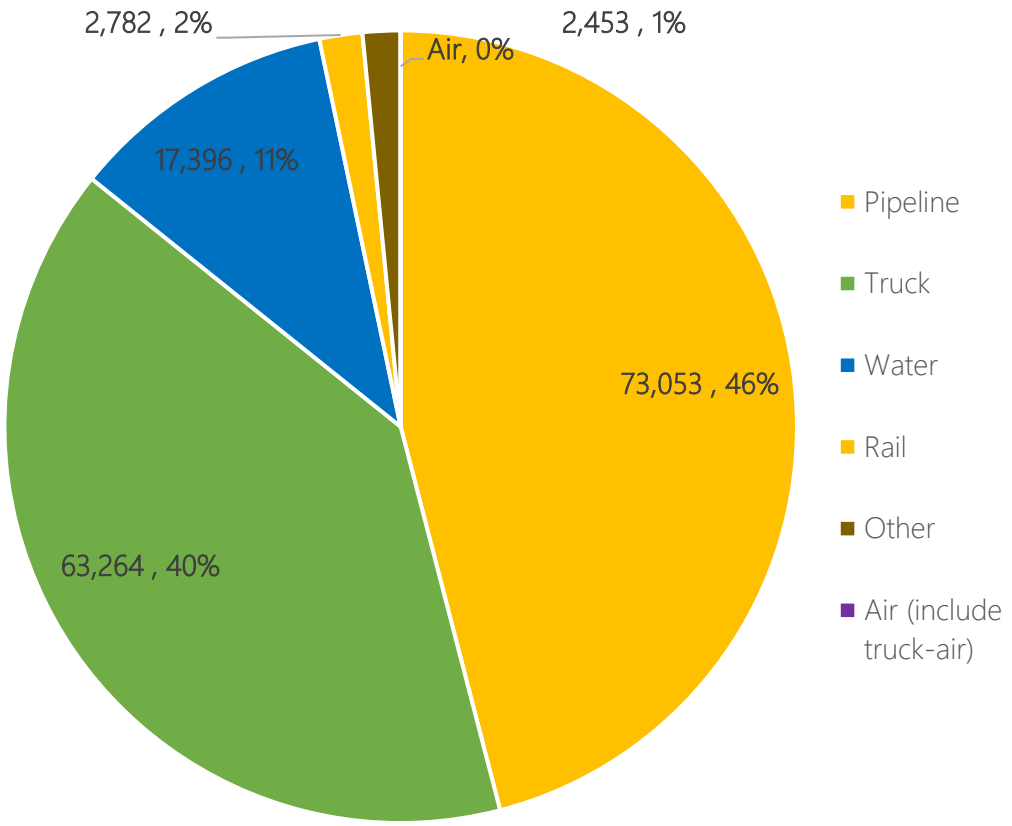
Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity trade flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

International imports represent nearly 7 percent of total (combined domestic and international) Florida imports, clearly indicating that Florida relies in part on international sources of energy products. The findings from the energy supply chain market analysis help inform supply chain resilience planning and development of strategies associated with the potential geographical effects of domestic and international disruptions impacting the supply chain.

2.3 Supply Chain Dominant Freight Modes

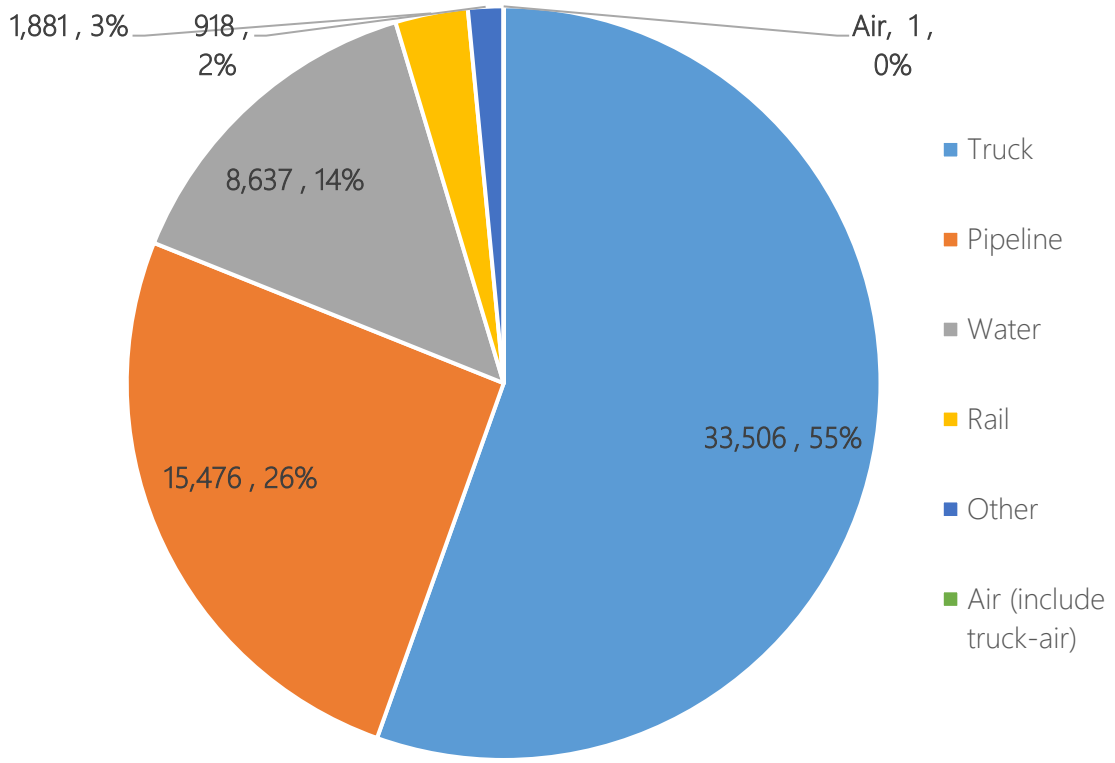
Figure 3. and Figure 4. show the mode split by tonnage and value for the combined intra, inbound, and outbound flows for the energy supply chain. Pipeline and truck are the dominant modes, moving 86 percent of total tonnage and 81 percent of total value. Truck handles a smaller share of tonnage compared to pipeline but moves more valuable goods for the supply chain. Water is another important mode (ranking 3rd), moving 11 percent and 14 percent of total tonnage and value, respectively.

FIGURE 3. FLORIDA ENERGY SUPPLY CHAIN - TONNAGE (THOUSAND TONS) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS IN 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

FIGURE 4. FLORIDA ENERGY SUPPLY CHAIN - VALUE (MILLION USD) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS IN 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

Table 10 and Table 11 show the mode split by tonnage, value and direction for each freight mode for the energy supply chain in the State. These results, which allow a more detailed examination of critical freight mode and their roles at each stage of the supply chain, indicate the following:

- Intra Flows – For the commodity flows originating and terminating within Florida, truck rank first by tonnage, accounting for 62 percent of total intra flows (60 million tons). Pipeline is the second leading dominant mode within Florida. These two modes together represent nearly 100 percent of commodity movements (by tonnage). By value, truck and pipeline also dominate, ranking first and second for intra movement, respectively, accounting for nearly 100 percent of total intra flows.
- Inbound Flows - For flows originating beyond Florida and terminating within Florida, the leading modes are pipeline and water, accounting for 92 percent of total inbound tonnage. While rail and truck each handle only 3 percent of total inbound tonnage, their respective contributions to the total inbound value are 8 percent and 7 percent. Despite their smaller share of tonnage, this highlights the economic significance of both rail and truck freight for the delivery of refined energy products to customers.
- Outbound Flows - For flows originating within Florida and terminating beyond Florida, truck and rail are the dominant modes by tonnage and value (USD). Truck and rail account for 49 percent and 39 percent of total tonnage, respectively, and 69 percent and 28 percent by value. Water is the third

dominant mode, moving 5 percent of total outbound tonnage and 2 percent of total outbound value in the State.

Pipeline and truck are the dominant freight modes for the energy supply chain in Florida. Pipeline has the largest share of total tonnage and the second largest share of total value (USD). Truck has the second largest share of total tonnage and the largest share of total value (USD), and plays a key role given its widespread use for intra state movements. Water has the third largest share for both tonnage and value (USD), and plays a crucial role for inbound movements. Truck and rail are the dominant modes for outbound movements, underscoring their significance in transporting goods that originate in Florida and terminate beyond Florida. These findings offer valuable insights for shaping policies and strategies aimed at enhancing goods movement and resilience across all stages of the energy supply chain.

TABLE 10. FLORIDA ENERGY SUPPLY CHAIN - MODE SPLIT BY TONNAGE IN 2022

	Tonnage (Percentage)			
Mode	**Intra**	**Inbound**	**Outbound**	**Total by Mode**
Truck	60,461 (62%)	1,712 (3%)	1,091 (49%)	63,264
Rail	400 (<0.1 %)	1,502 (3%)	879 (39%)	2,782
Water	299 (<0.1 %)	16,988 (29%)	109 (5%)	17,396
Air (include truck-air)	<0.1 (<0.1 %)	<0.1 (<0.1 %)	<0.1 (<0.1 %)	<0.1
Pipeline	35,966 (37%)	37,086 (63%)	1 (<0.1 %)	73,053
Other	487 (<0.1 %)	1,802 (3%)	163 (7%)	2,453
Total by Direction	97,614 (100%)	59,091 (100%)	2,244 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

TABLE 11. FLORIDA ENERGY SUPPLY CHAIN - MODE SPLIT BY VALUE IN 2022

	Value (Percentage)			
Mode	**Intra (Million USD)**	**Inbound (Million USD)**	**Outbound (Million USD)**	**Total by Mode**
Truck	$ 31,179 (77%)	$1,380 (7%)	$947 (69%)	$33,506
Rail	$95 (<0.1 %)	$1,402 (8%)	$384 (28%)	$1,881
Water	$31 (<0.1 %)	$8,578 (47%)	$28 (2%)	$8,637
Air (include truck-air)	<$0.1 (<0.1 %)	$1 (<0.1 %)	<$0.1 (<0.1 %)	$ 1
Pipeline	$9,191 (23%)	$6,285 (34%)	$1 (<0.1 %)	$15,476
Other	$133 (<0.1 %)	$764 (4%)	$21 (2%)	$ 918
Total by Direction	$40,629 (100%)	$18,409 (100%)	$1,381 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19).

2.4 Initial Qualitative Assessment of Areas of Risk

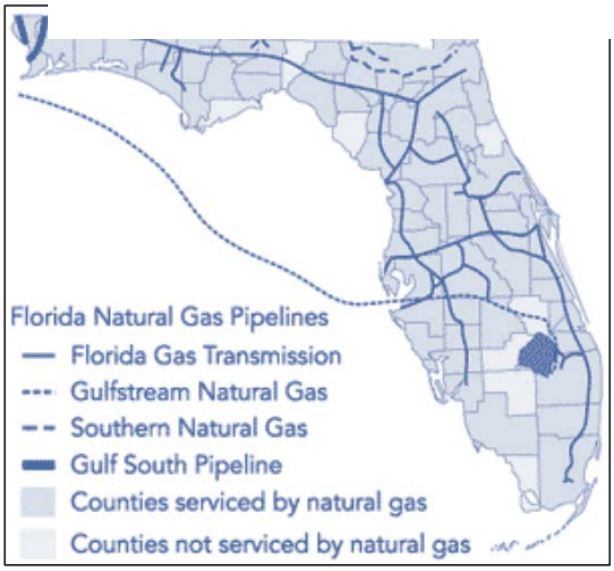
Critical Florida Transportation Network Components for the Energy Manufacturing Sector

The energy supply chain relies on many parts of Florida's Strategic Intermodal System (SIS) to distribute energy products across the state.. As noted in Section 2.3, several of Florida's seaports import and store petroleum products including gasoline and jet fuel. After these commodities enter the state, they are mainly distributed by pipeline and truck to reach critical locations such as airports and gas stations.

The most critical seaports for the energy supply chain include Port Everglades, Port Tampa Bay, Port Canaveral, JAXPORT, and SeaPort Manatee. Each have a crucial role in importing energy commodities needed to support Florida's economy and quality of life. Port Everglades alone is responsible for providing one-third of Florida's energy requirements including jet fuel and gasoline, serving twelve (12) counties and four (4) international airports.[16] SeaPort Manatee provides a critical connection to the Gulfstream Natural Gas Pipeline, transporting an estimated 1.3 billion cubic feet of natural gas each day, serving Florida's electric utility companies.[17]

Although pipelines are not designed SIS facilities, it is important to note their role in moving energy across and to Florida. Figure 5 shows Florida's natural gas pipelines. The northwest region is served by the Southern Natural Gas Pipeline and the Sabal Trail Transmission Pipeline, distributing energy through the central portion of the State. Central Florida is also served by the Gulfstream Pipeline, which travels across the Gulf of Mexico and through SeaPort Manatee. While the Gulf South Pipeline only distributes commodities to the panhandle, the Florida Gas Transmission Pipeline serves essentially all of Florida's counties, ranging from the northwest region through central and south Florida. These pipelines are essential to moving natural gas and powering the electric grid. In addition, the Central Florida Pipeline transfers jet fuel between the Port Tampa Bay directly to the Orlando International Airport, whereas the Everglades Pipeline provides connections from Port Everglades to both the Fort Lauderdale and Miami International Airports. Florida's SIS airport system relies on the delivery of jet fuel, across multiple modes, to support thousands of flights each day.

FIGURE 5. FLORIDA NATURAL GAS PIPELINES

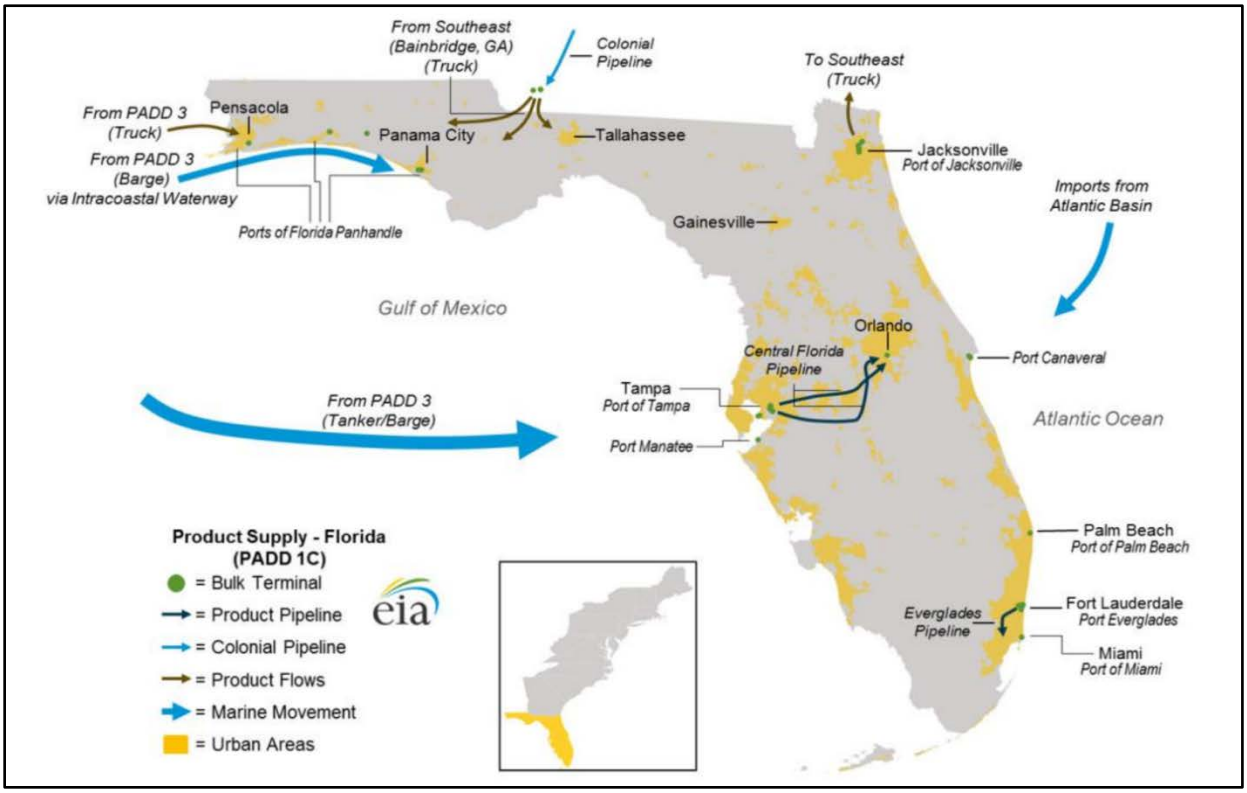


16 Petroleum (porteverglades.net).

17 Gulfstream Natural Gas System (gulfstreamgas.com).

Gasoline and petroleum products arrive in Florida by vessel, pipeline, truck and barge (Figure 6).[18] Gasoline shipments arriving by vessel are trucked or transported by pipelines to nearby markets. In western Florida, gasoline is trucked from terminals in Port Tampa Bay. In southern Florida, gasoline is trucked from terminals in Port Everglades. In central Florida, gasoline is transported by pipeline from Tampa and petroleum products are trucked from Port Canaveral. In northeastern Florida, gasoline is trucked from terminals in JAXPORT. Gasoline shipments for delivery to the Florida panhandle come from a terminal in Bainbridge, Georgia; these shipments are transferred from the Colonial Pipeline System to a long-distance tanker truck. Gasoline shipments from nearby refineries in Alabama and Mississippi are transported by truck and barge (moving by the Intracoastal Waterway) to the rest of western Florida. [19]

FIGURE 6. FLORIDA PETROLEUM PRODUCTS SUPPLY MOVEMENTS



Source: U.S. Energy Information Administration.

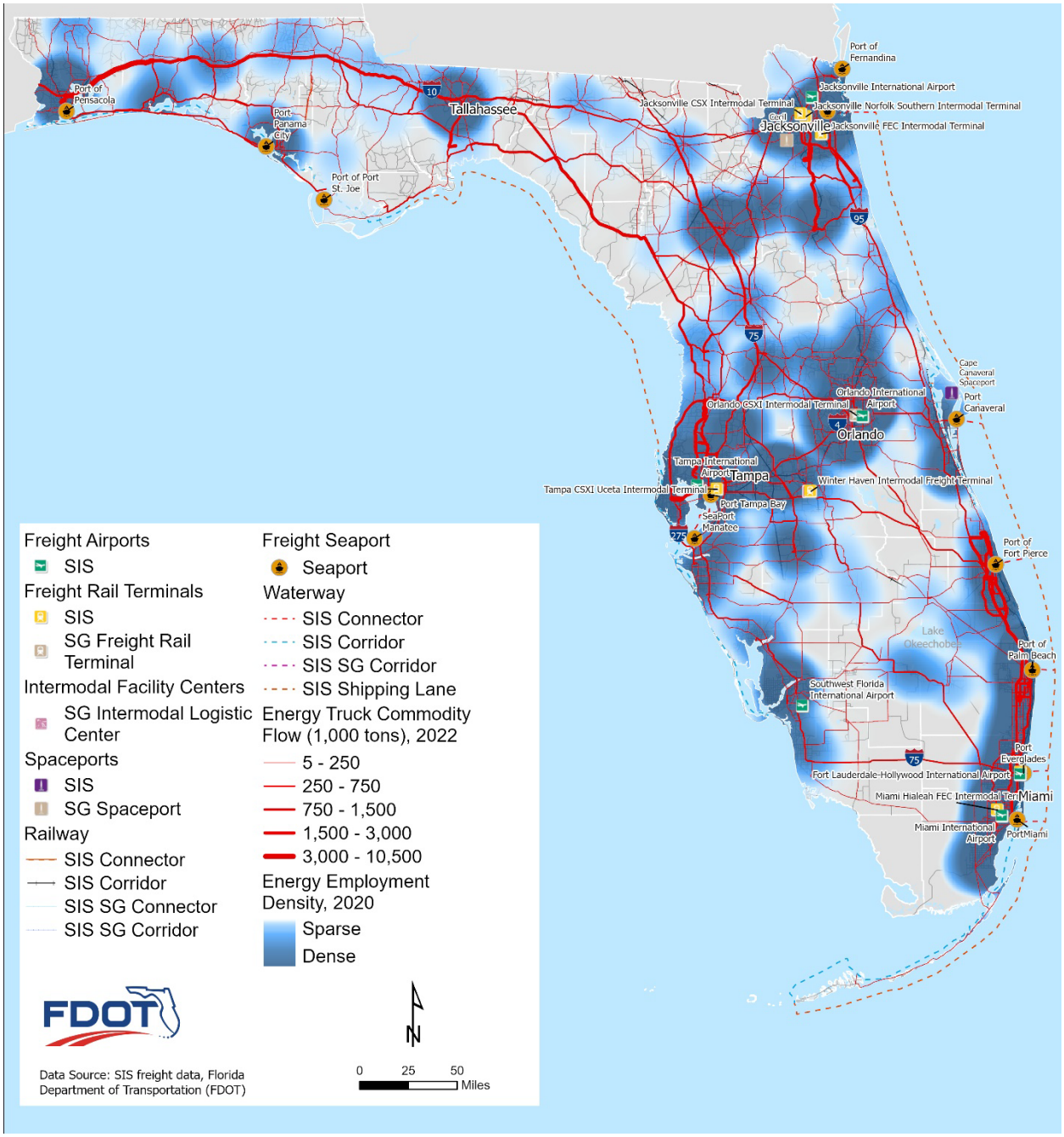
Figure 7 illustrates truck commodity flows and concentration of employers for the energy supply chain in the State. The distribution of truck flows highlights the pivotal role of I-10 in connecting supply chain movements in the Florida Panhandle region with the broader state. Within Hillsborough County, I-4, I-75, and I-275 serve as key corridors for goods movement, likely due to their linkage with Port Tampa Bay, a crucial gateway between West and Central Florida. In Miami-Dade County, I-95 emerges as a significant interstate corridor facilitating

18 U.S. Energy Information Administration. Hurricane Ian temporarily disrupts Florida's gasoline supply chain - U.S. Energy Information Administration (EIA).

19 U.S. Energy Information Administration. Hurricane Ian temporarily disrupts Florida's gasoline supply chain - U.S. Energy Information Administration (EIA).

substantial movements. Moreover, I-95 plays a vital role in North Florida's supply chain movement. Notably, in North Florida, US 17 also serves as a crucial corridor for the supply chain. Employment associated with the supply chain predominantly concentrates in major metropolitan areas across Florida, encompassing Miami, Fort Lauderdale, West Palm Beach, Tampa, Cape Coral, Lakeland, Orlando, Gainesville, Jacksonville, Tallahassee and Pensacola.

FIGURE 7. FLORIDA ENERGY SUPPLY CHAIN - COMMODITY FLOWS BY TRUCK AND EMPLOYMENT DENSITY



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved by truck in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

Disruptor Events and Areas of Risk

Florida's environment, economy, and population place significant demand on the energy supply chain. Essentially all transportation movements including both people and freight rely on timely and sufficient supply of petroleum to travel via airplane, cargo truck, cruise ship, transit, or personal motor vehicle. Due to its large residential and tourist populations, Florida ranks third highest in the nation in motor gasoline and jet fuel consumption.[20] Additionally, Floridian's rely on natural gas to supply electricity to their businesses and households. In 2022 alone, households consumed 54 percent of the electricity used in the State for heating and air conditioning.[21] Disruption of the energy supply chain has the potential to cause extreme consequences, highlighting the critical need to develop a resilient and redundant system.

The State's proximity to the Gulf of Mexico and the Atlantic Ocean exposes transportation infrastructure to hurricanes and tropical storms bringing heavy rainfall, high winds, and flooding. Since 2018, Florida has experienced several major hurricanes including Hurricane Ian (2022), Hurricane Dorian (2019), and Hurricane Michael (2018), all of which led to mass evacuations of 2.5 million residents that relied on adequate fuel supply from their local gas stations.[22] Hurricanes also cause severe disruptions to Florida's power grid, in one case leaving an estimated 2.7 million residents and businesses without electricity.[23]

The energy supply chain is also susceptible to human-made hazards that include cyberattacks on pipelines and marine incidents resulting in blocked or restricted seaport channels, among others. In 2021, the cyberattack on the Colonial Pipeline posed a severe threat to Florida's fuel supply, promoting an executive order for emergency relief efforts to increase the supply of gasoline, diesel fuel, jet fuel, and other petroleum products to meet statewide demands.[24] Additionally, Port Everglades recently recognized the importance of increasing statewide and regional awareness of a seaport restriction or blocked channel event and its potential disruptions to every-day supply chains. This initiative resulted in a set of guidance protocols aimed to mitigate, respond to and recover from supply chain disruption to fuel supply.

In light of recent disruptor events, there is an increased interest in the topic of energy supply chain resilience, particularly fuel. As such, FDOT conducted the Florida Fuel Resiliency and Supply Chain workshop in 2023. The workshop included 74 attendees representing 16 industry groups, from Harbor Pilots to gas stations. Workshop participants identified several fuel supply chain pinch points across five major themes. Table 12 describes these pinch points, providing critical insight into several areas of risk for the fuel supply chain in Florida.

TABLE 12. FLORIDA FUEL RESILIENCY AND SUPPLY CHAIN WORKSHOP PINCH POINTS

[20] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
[21] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
[22] Hurricane Ian, Broward County News Hurricane Ian nears Category 5 strength with winds of 155 mph, top storm surge estimate goes to 18 feet – Broward.US
[23] Hurricane Ian, FEMA Hurricane Ian – Response and Recovery | FEMA.gov
[24] Florida Secretary's Emergency Order Pursuant to EO 21-105 (Colonial Pipeline) | FMCSA (dot.gov)

Theme	Most common pinch points identified
Physical infrastructure and redundancy	• Lack of redundancy across fuel supply chain (e.g., source of supply, geographically, distribution networks) • Limited pre-positioning of and access to equipment required for recovery (e.g., back-up power equipment, channel surveying equipment, fuel trucks)
Media and public sentiment	• Absence of common understanding, definition of key terms, provision of information in limited number of languages (e.g., days of fuel, port "open" vs. "closed") • Education and consistent engagement with key media points of contact and coordination of messaging across stakeholders (e.g., different information being shared by different stakeholders); clear points of contact within each entity • Misplaced public sentiment resulting in demand spikes (e.g., daily "top-off" with average purchases of four gallons, filling plastic bags with gasoline)
Centralized real-time data visibility	• Lack of visibility into fuel storage levels at fuel terminals (e.g., type of product available, days of fuel, incoming/outgoing products) • Lack of real-time information sharing (e.g., available routes, fuel availability at retail stations)
Labor and transport availability	• Challenges to fuel delivery throughput (e.g., supplemental truck and driver capacity) • Time loss due to congestion (e.g., at fuel terminals, on the roads, at retail stations)
Regulatory requirements and rapid response waivers	• Credentialing (e.g., port TWIC requirements, non-standard certifications across terminals) • Existing waiver process (e.g., lengthy waiver request process, high degree of uncertainty before/during event, different forms and requirements across jurisdictions/waiver types)

Source: Florida Department of Transportation.

Similar to the rest of the nation, Florida is identifying opportunities to diversify its transportation energy supply chain to decrease over reliance on specific energy sources, like fuel. As such, the state continues to invest in alternative energy sources including solar and fossil fuels to support the movement of both people and freight. Alternative fueling technology, such as electric vehicle charging stations are potential solutions to promote energy independence and increase supply chain resilience. However, these solutions also require a redundant and resilient power grid.

Potential Impacts to Florida's Transportation System

The following section describes the initial assessment to identify how and where disruption events including storm surge, floodplain, wildfire, sinkhole, sea level rise, severe thunderstorm, and extreme heat may impact Florida's transportation infrastructure, including designated SIS facilities, that support the energy supply chain. A description of these risks, particularly in regard to loss of transportation network and supply chain reliability is provided below. Table 13 provides a summary of key takeaways following this discussion.

Storm Surge

Depending on storm severity, storm surge poses a significant risk to energy operations across all critical energy-related seaports, limiting access to energy storage facilities and highways due to a rise in sea level along the coast. As shown in Figure 4, storm surge has the greatest risk of disrupting the energy supply chain in the panhandle, northwest, northeast, gulf coast, and southern regions. Storm surge exposure along the space coast is prevalent, yet limited.

In the panhandle and northwest regions, storm surge may disrupt commodity flows along I-10, a critical highway providing connections from Port Tampa Bay to Tallahassee and Pensacola. Along the gulf coast, disruptions may occur at the Port Tampa Bay, SeaPort Manatee, and truck travel along I-275, providing connections to I-4, the Tampa International Airport, and the Orlando CSXI Intermodal Terminal. Storm surge in the northeast may

impact JAXPORT, and commodities traveling on I-95, I-295, US-1 and US-17. Additionally, local communities near the JAXPORT may be at risk due to storm surge limiting access to local fueling stations, similar to Port Tampa Bay and Port Everglades. In the south, storm surge may impact Port Everglades and truck travel along I-95 as well as I-595, providing connections to Miami and Naples.

The threat of storm surge is coupled with extreme weather events, requiring rapid preparation, response and recovery of the energy supply chain. Pre-event activities such as port closures limit access to fuel reserves, reduce truck distribution availability, suspend airport operations, and often result in panic-buying of fuel causing congestion on roadways near location gas stations. Additionally, post-event recovery activities can result in long trucking queues, roadway congestion, blocked or limited access to fuel terminals, and prolonged power outages.

Floodplain

As shown in Figure 5, both the 100 and 500 year floodplains have the potential to impact all aspects of the energy supply chain in every region of the State. The 100 year floodplain poses a threat to all critical energy-related seaports, truck travel routes, and dense employment hotspots. The 500 year floodplain may cause more severe disruptions to dense urban areas whether on the coast or inland, including the southern regions of Fort Lauderdale and Miami. Similar to storm surge, flood water has the potential to cause roadway washouts, and structural damage to fuel and electrical facilities.

Wildfire

Wildfires pose limited risk to Florida's critical energy-related seaports, yet moderate to high risk along inland commodity flow corridors. As shown in Figure 6, Port Tampa Bay, Port Everglades and Port Canaveral are exposed to minimal wildfire risk. However, JAXPORT and trucks traveling along I-95, I-295, US-1 and US-17 are moderately to highly exposed. Wildfire risk is most prevalent along I-10 in the panhandle and northwest regions, along with I-75 in the south. Wildfires have the ability to cause physical damage to both roadway and utility infrastructure such as powerlines, which disrupt both the electric grid and distribution of energy commodities.

Sinkhole

Sinkholes are most likely to occur and impact energy commodity flows in the northwest region of the State. As shown in Figure 7, sinkholes may impact the energy supply chain along I-10 and I-75, where trucks provide connections from the northern portion of the state to energy supplies from the gulf coast. The Sabal Trail Pipeline is also vulnerable, as it enters the State through Hamilton County where sinkholes are most likely, and distributes fuel to the Orlando CSXI Intermodal Terminal. Sinkholes have the potential to damage both the pipeline and roadway system, creating disruptions within energy distribution. Depending on the size and severity of a sinkhole event, pipelines and roadways could be severely damaged, resulting in pipeline shutdowns and road closures causing congestion and delays.

Sea Level Rise

As shown in Figure 8, sea level rise poses significant risk to all critical energy-related seaports, as it's a predominantly a coastal hazard. Similar to the risk from storm surge, the rise of ocean levels may impact fuel operations to all critical seaports and connecting coastal transportation infrastructure including I-95, I-275, I-

295, and US-17. Unlike temporary storm surge, sea level rise may cause permanent inundation. Operational adaptations may be required to ensure fueling docks and terminals remain accessible. Without access to seaport fueling infrastructure, the State may be forced to rely on pipelines and trucks to bring energy into the State.

Severe Thunderstorm

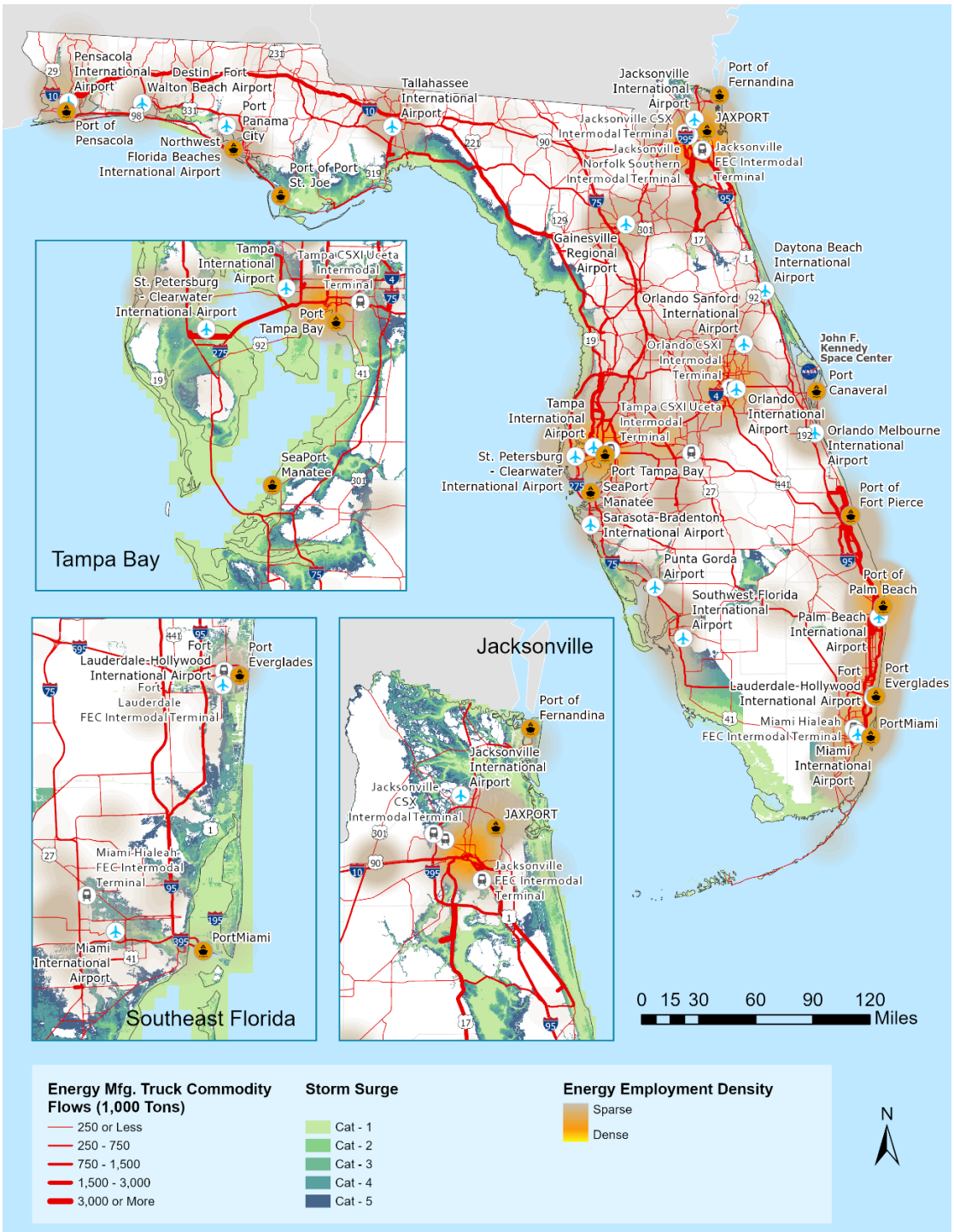
Severe thunderstorm accounts for the potential of both lightning and high winds. As shown in Figures 9, lightning risk is very high across all regions of the state. Lightning strikes have the potential to strike electric utilities and gas lines, causing power outages and gas leaks. As shown in Figure 10, strong winds are most likely to occur in the panhandle, northwest, and central regions of the state. Extreme winds may delay truck travel along several critical highways supporting the energy supply chain, and damage utility infrastructure resulting in power outages.

Extreme Heat

Due to Florida's proximity to the Gulf of Mexico and Atlantic Ocean, the State's coastline experiences fewer days (0-20) with temperatures over 95 degrees. However, inland areas especially in the central, gulf coast, and south regions may be subject to 31-50 days of extreme heat. As shown in Figure 11, Port Tampa Bay, Port Canaveral, and SeaPort Manatee are the most vulnerable to extreme temperatures. In regards to fuel distribution, commodity flows traveling via I-4, I-10 and I-75 may be disrupted by damages to roadway asphalt such as deterioration rutting and buckling.

In general, extreme heat will cause the greatest risk to Florida's electric grid. As temperatures rise, residents will continue to place more demand on electricity to keep their businesses and households cool, especially in the summer months. Extreme temperatures may also cause a strain on electric transmission lines, power plants, and electric motor vehicle charging stations, limiting operational capacity and increasing the risk of power outages.

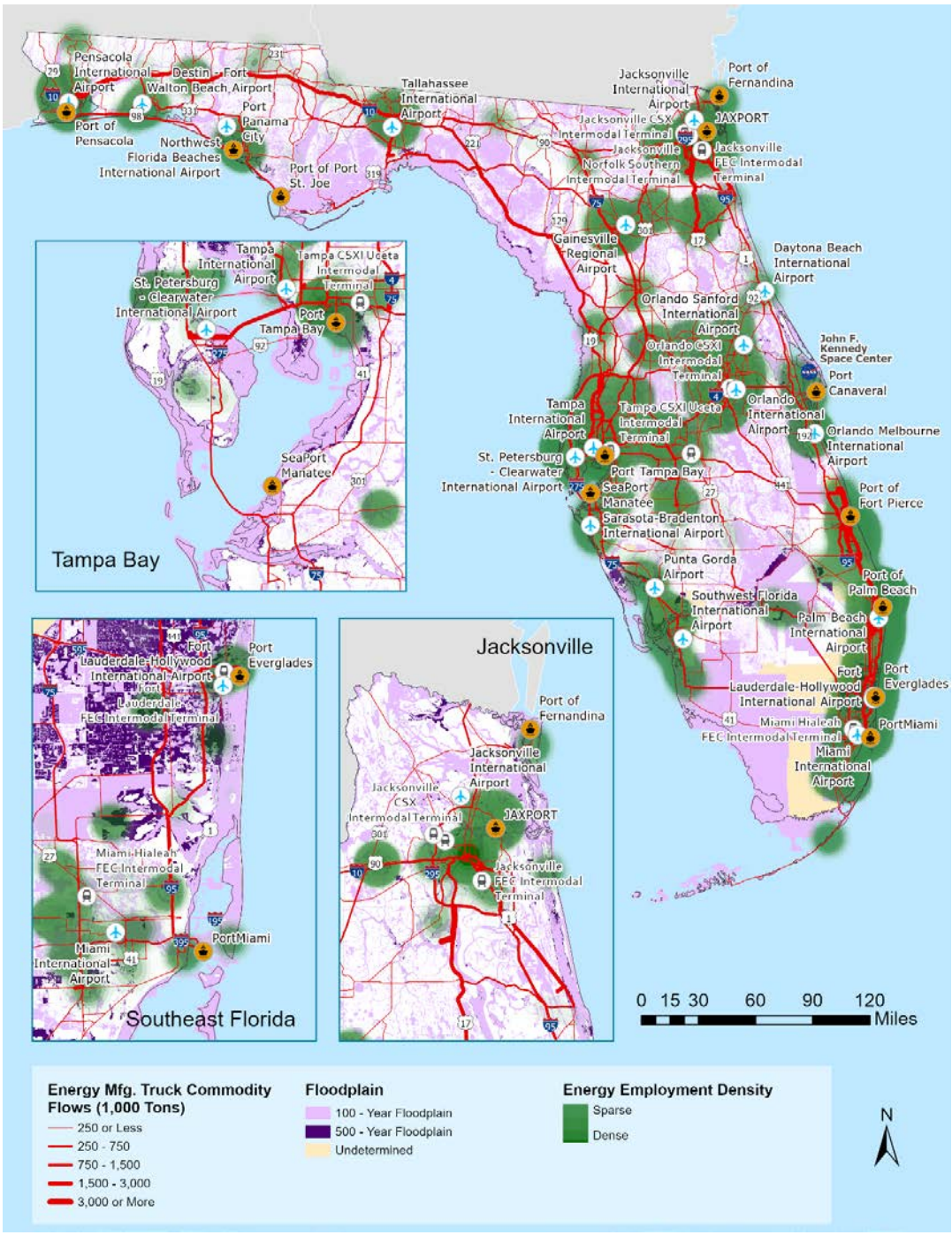
FIGURE 8. FLORIDA ENERGY SUPPLY CHAIN - STORM SURGE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

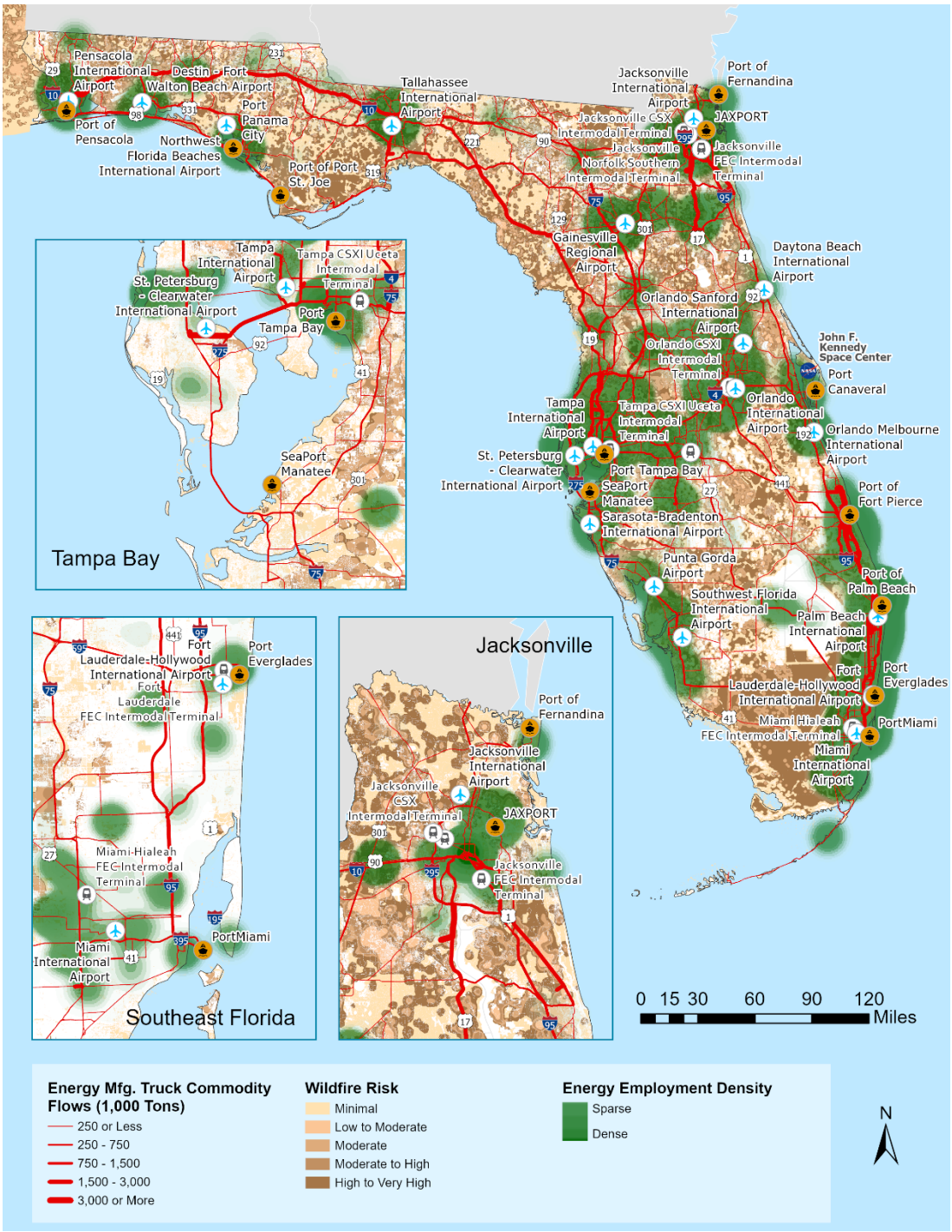
FIGURE 9. FLORIDA ENERGY SUPPLY CHAIN - FLOODPLAIN HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

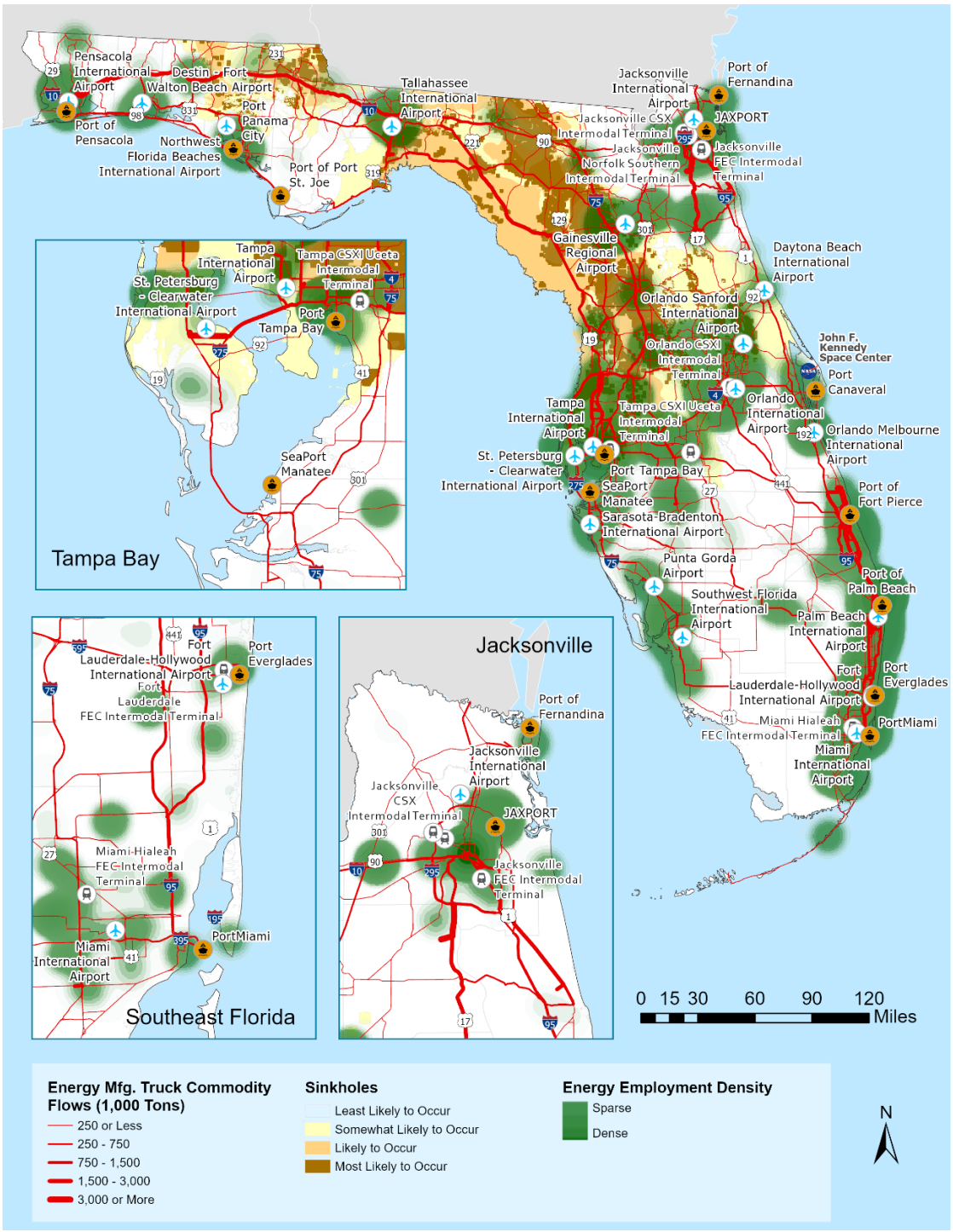
FIGURE 10. FLORIDA ENERGY SUPPLY CHAIN – WILDFIRE



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

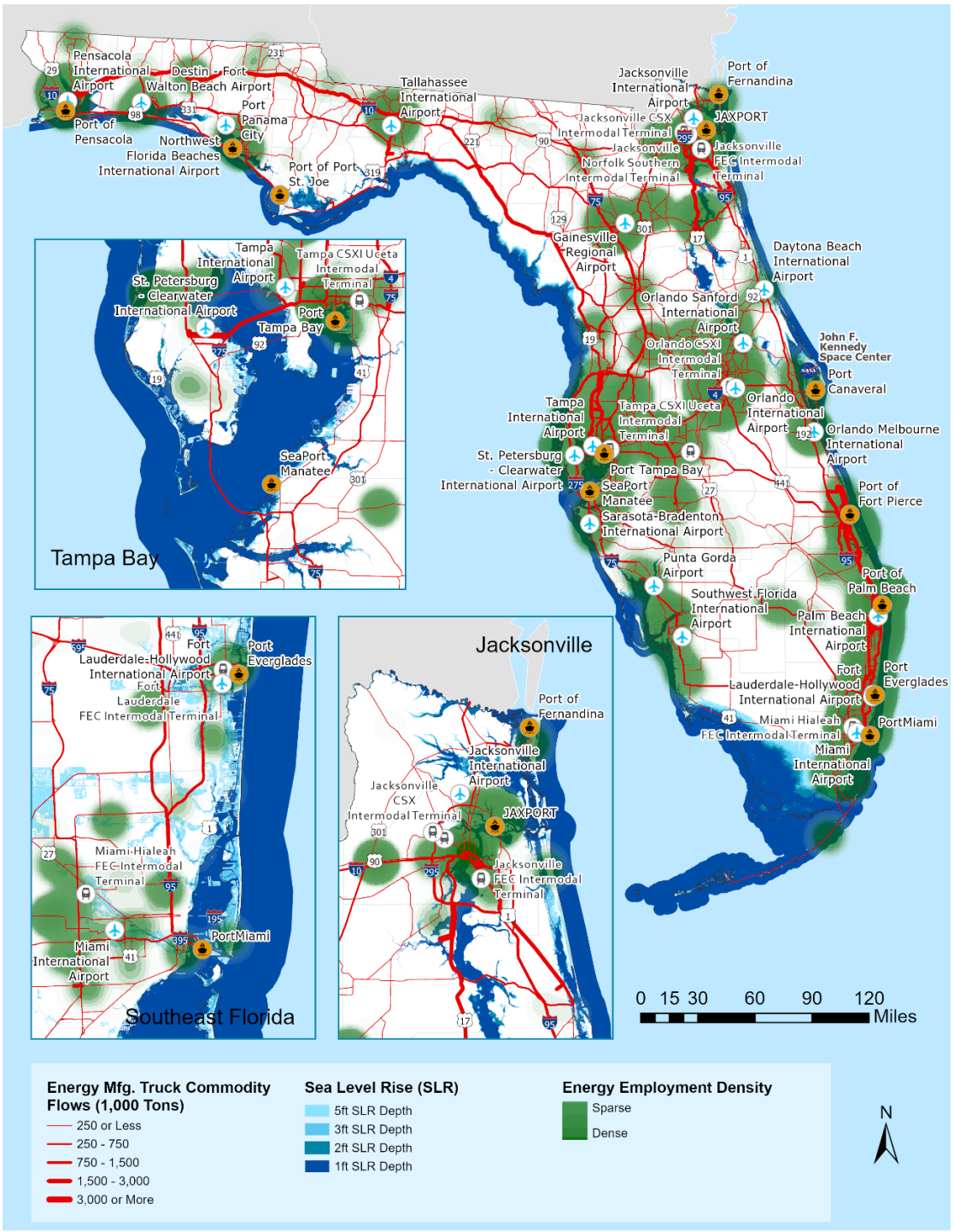
FIGURE 11. FLORIDA ENERGY SUPPLY CHAIN – SINKHOLES



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

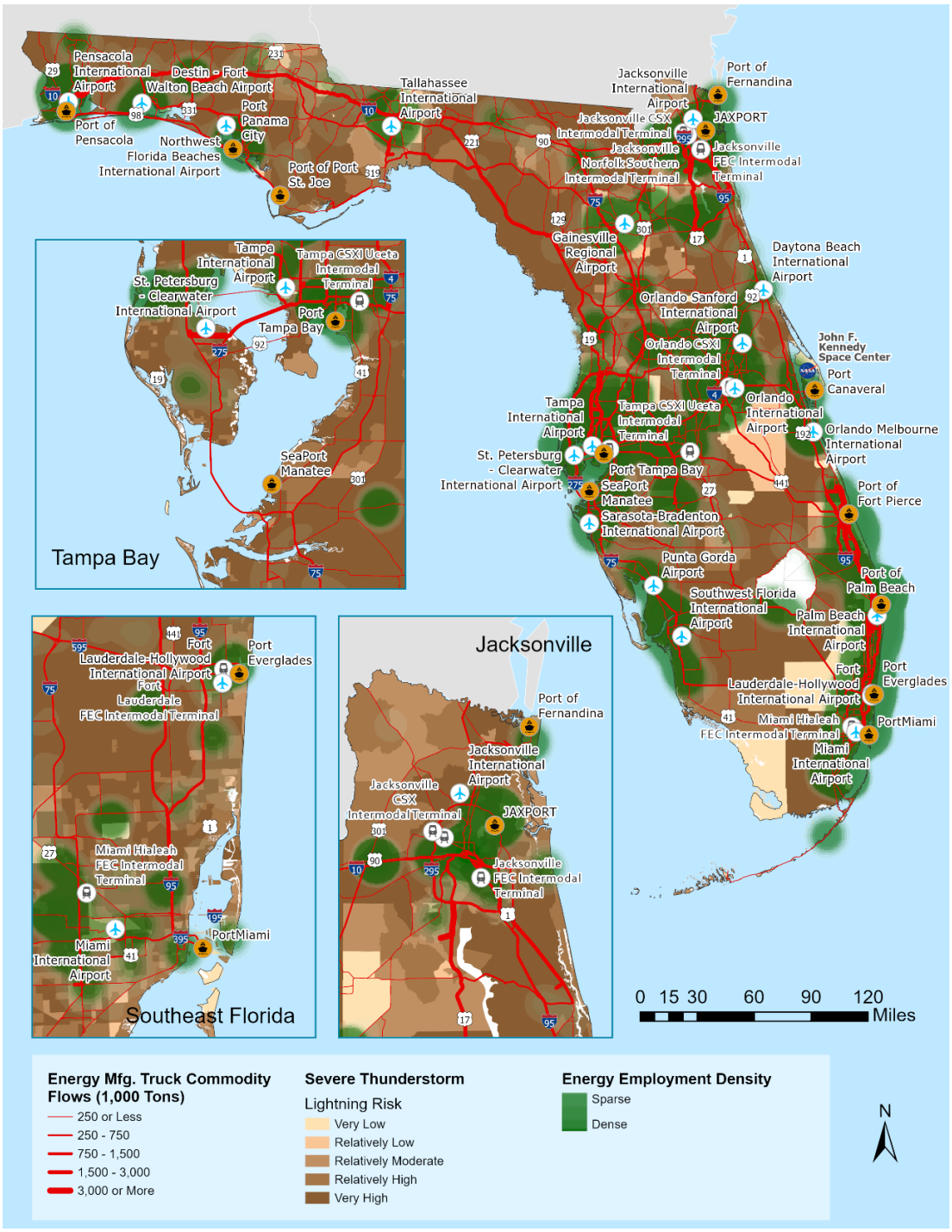
FIGURE 12. FLORIDA ENERGY SUPPLY CHAIN – SEA LEVEL RISE



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved n 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

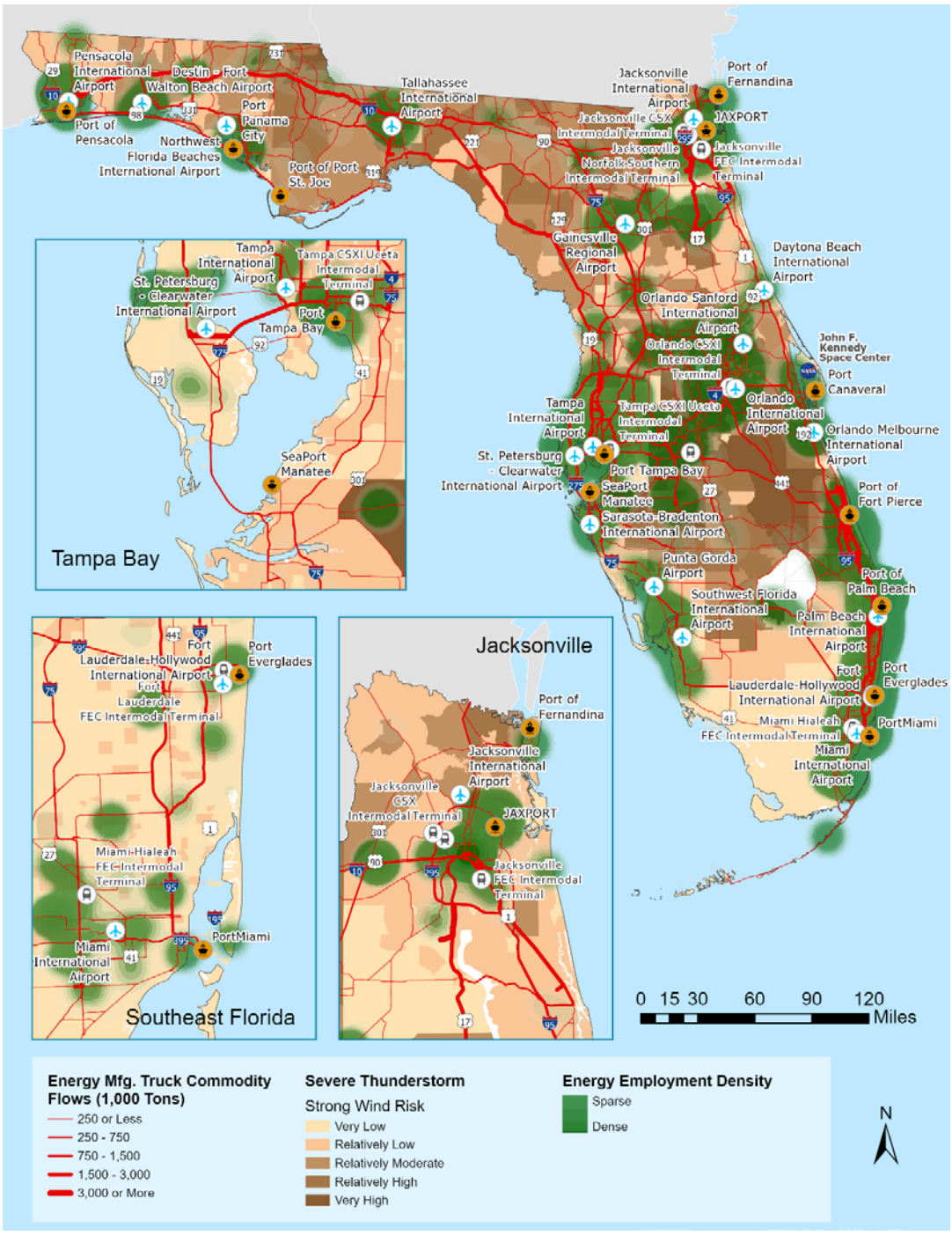
FIGURE 13. FLORIDA ENERGY SUPPLY CHAIN – SEVERE THUNDERSTORM (LIGHTNING)



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

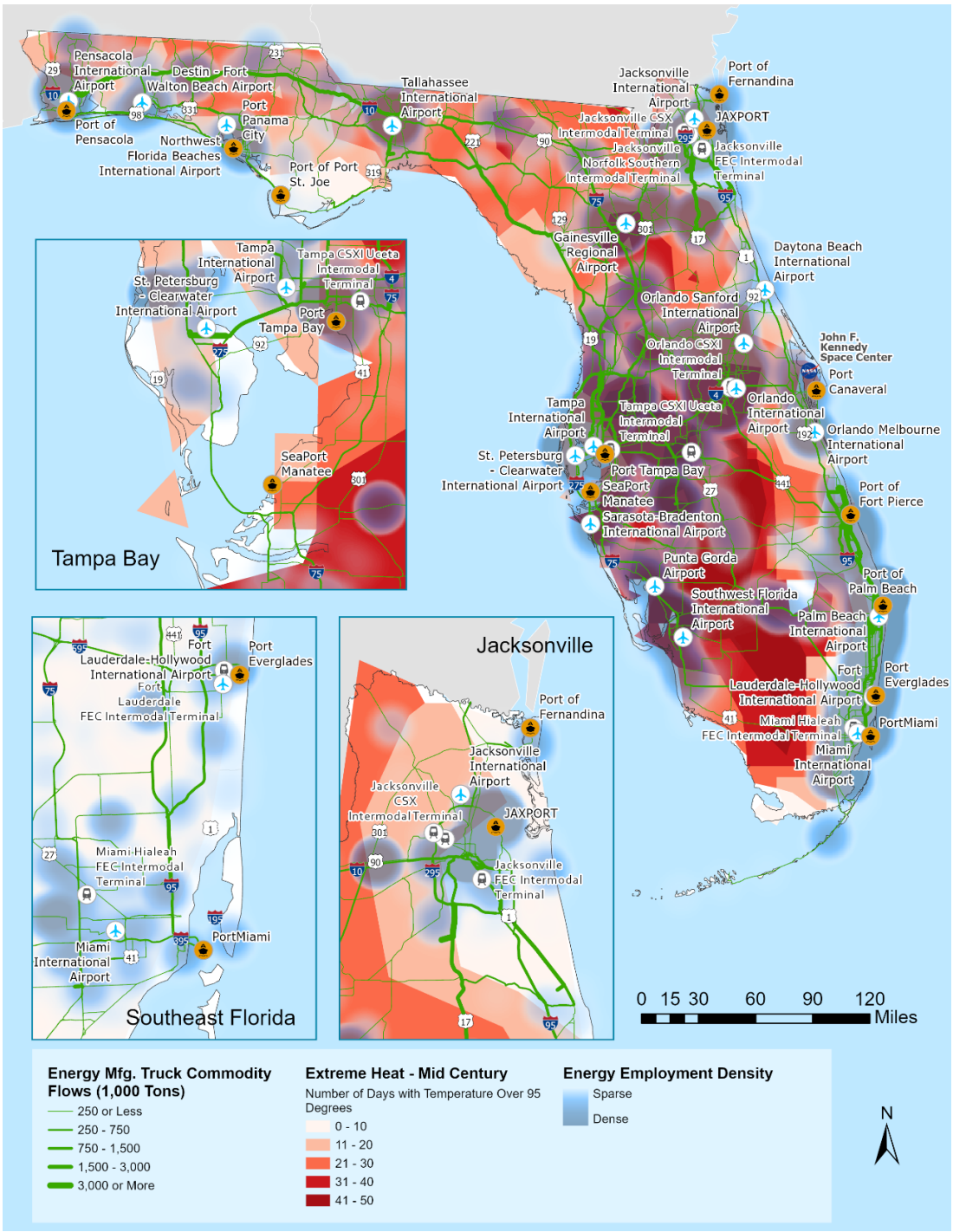
FIGURE 14. FLORIDA ENERGY SUPPLY CHAIN – SEVERE THUNDERSTORM (STRONG WIND)



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

FIGURE 15. FLORIDA ENERGY SUPPLY CHAIN – EXTREME HEAT (2036 - 2065)



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database for Florida.

Note: Energy commodity tons include crude petroleum (SCTG 16), gasoline (SCTG 17), fuel oils (SCTG 18), and natural gas and other fossil products (SCTG 19) moved in 2022. Energy employment density includes employment in Natural Gas Distribution (NAICS 22121), Electric Power Generation, Transmission and Distribution (NAICS 2211), and Petroleum and Petroleum Products Merchant Wholesalers (NAICS 4247) in January 2020.

TABLE 13. INITIAL QUALITATIVE ASSESSMENT OF AREAS OF RISK FOR THE ENERGY SUPPLY CHAIN IN FLORIDA

Disrupter Event	Vulnerable Regions and Transportation Infrastructure	Impact on the Energy Supply Chain
Storm Surge	Storm surge poses a significant risk to energy operations across all critical energy-related seaports in Florida, limiting access to energy storage facilities and highways due to a rise in sea level along the coast.	The threat of storm surge is coupled with extreme weather events, requiring rapid preparation, response and recovery of the energy supply chain. Pre-event activities such as port closures limit access to fuel reserves, reduce truck distribution availability, suspend airport operations, and often result in the panic-buying of fuel causing congestion on roadways near location gas stations. Additionally, post-event recovery activities can result in long trucking queues, roadway congestion, blocked or limited access to fuel terminals, and prolonged power outages.
Floodplain	Floodplains have the potential to impact all aspects of the energy supply chain in every region of the State.	Flood water may cause roadway washouts, and structural damage to fuel and electrical facilities.
Wildfire	Wildfires pose limited risk to Florida's critical energy-related seaports, yet moderate to high risk along inland commodity flow corridors. Wildfire risk is most prevalent along I-10 in the panhandle and northwest regions, along with I-75 in the south.	Wildfires have the ability to cause physical damage to both roadway and utility infrastructure such as powerlines, which disrupt both the electric grid and distribution of energy commodities.
Sinkhole	Sinkholes are most likely to occur and impact energy commodity flows in the northwest region of the State.	Sinkholes have the potential to damage both the pipeline and roadway system, creating disruption within energy distribution. Depending on the size and severity of a sinkhole event, pipelines and roadways could be severely damaged, resulting in pipeline shutdowns and road closures causing congestion and delays.
Sea Level Rise	Sea level rise poses significant risk to all critical energy-related seaports in Florida, as it is a predominantly coastal hazard.	Operational adaptations may be required to ensure fueling docks and terminals remain accessible. Without access to seaport fueling infrastructure, the State may be forced to rely on pipelines and trucks to bring energy into the State.
Severe Thunderstorm	Lightning risk is very high across all regions of the State, whereas strong winds are most likely to occur in the panhandle, northwest, and central regions of the state.	Lightning has the potential to strike electric utilities and gas lines, causing power outages and gas leaks. Strong winds may delay truck travel along several critical highways and damage utility infrastructure, resulting in power outages.

Disrupter Event	Vulnerable Regions and Transportation Infrastructure	Impact on the Energy Supply Chain
Extreme Heat	Extreme heat will cause the greatest risk to Florida's electric grid. Extreme heat also poses a threat to Port Tampa Bay, Port Canaveral, and SeaPort Manatee. Additionally, commodity flows traveling via I-4, I-10, and I-75 may be impacted.	Extreme heat may disrupt truck corridor travel due to roadway asphalt deterioration, rutting, and buckling. As temperatures rise, residents will place more demand on the electrical grid. Energy infrastructure may be strained in terms of operational capacity, increasing the risk of power outages.

Source: Cambridge Systematics Analysis.

2.5 Supply Chain Structure and Diagram

The analysis of the Florida energy supply chain focuses on electricity generation and refined fuel distribution as the two critical sectors for resilience within the energy sector. Figure 16 and Figure 17 offer a graphical illustration of both components of the supply chain. Each node in these diagrams represents a key stage/facility in the supply chain lifecycle. Color-coded arrows between each node represent the modal transport that moves the commodity from one conceptual node to another, with each color representing a different modal transport as indicated in the legend. The diagrams focus on adequately capturing major commodity flows and modal usage. The diagrams are meant to capture general flows and will not fully capture the nuances of any supply chain of any specific industry.

Florida Electricity Supply Chain Diagram

Florida's electricity supply chain diagram is shown in Figure 16. The first step in the energy supply chain is the acquisition of fuels that are needed to support electricity generation, transportation, commercial and industrial activities, as well as the residential sector in the State. Florida gets refined petroleum products, natural gas, coal and other refined products from several states including Alabama, Louisiana, Texas, and Georgia, and overseas. Refined fuels are delivered to Florida by various transportation modes including truck, tankship, rail, and pipeline. Natural gas, for instance, is brought to the State by interstate and subsea pipelines such as the Gulf Stream Natural Gas System Pipeline and the Florida Gas Transmission Pipeline,[25] whereas refined petroleum and petroleum products are supplied by truck, rail, and ships.[26]

Refined petroleum marine cargo arrives at ports including Port Tampa Bay, Port Everglades, Port Canaveral, and JAXPORT. [27] The refined gasoline delivered to Port Everglades comes from refineries in Louisiana, Mississippi and Texas. From the storage terminals at these ports, gasoline and other refined petroleum products are distributed to local markets via pipeline and tanker trucks. Coal supplies arrive to Florida by rail and marine cargo. Coal supplies come mainly from Colombia, Kentucky and Tennessee, and are distributed to local markets via rail.

The second stage is the energy transformation that occurs at power plants. Power plants in Florida are mainly fueled by natural gas. Seventy-four percent of Florida's power plants are fueled primarily by natural gas, whereas the remaining power plants are nuclear (12 percent), or fueled by renewable sources (solar and biomass, 7 percent) or coal (6 percent). Most of Florida's power plants can switch between natural gas and oil as a backup alternative in the presence of a disruptive event. Florida is also home to five commercial nuclear reactors located at three sites: two units at St. Lucie (Jensen Beach), two units at Turkey Point, and one at Crystal River.[28] Florida Power & Light Co. operates the first four reactors, while the commercial nuclear reactor at Crystal River is undergoing decommission according to the U.S. Nuclear Regulatory Commission (NRC). After

[25] U.S. EIA, International and Interstate Movements of Natural Gas by State, Florida, Annual, 2017-22.

[26] U.S. EIA, FLORIDA *State Profile and Energy Estimates*. Profile Data. https://www.eia.gov/state/data.php?sid=FL accessed March 15, 2024.

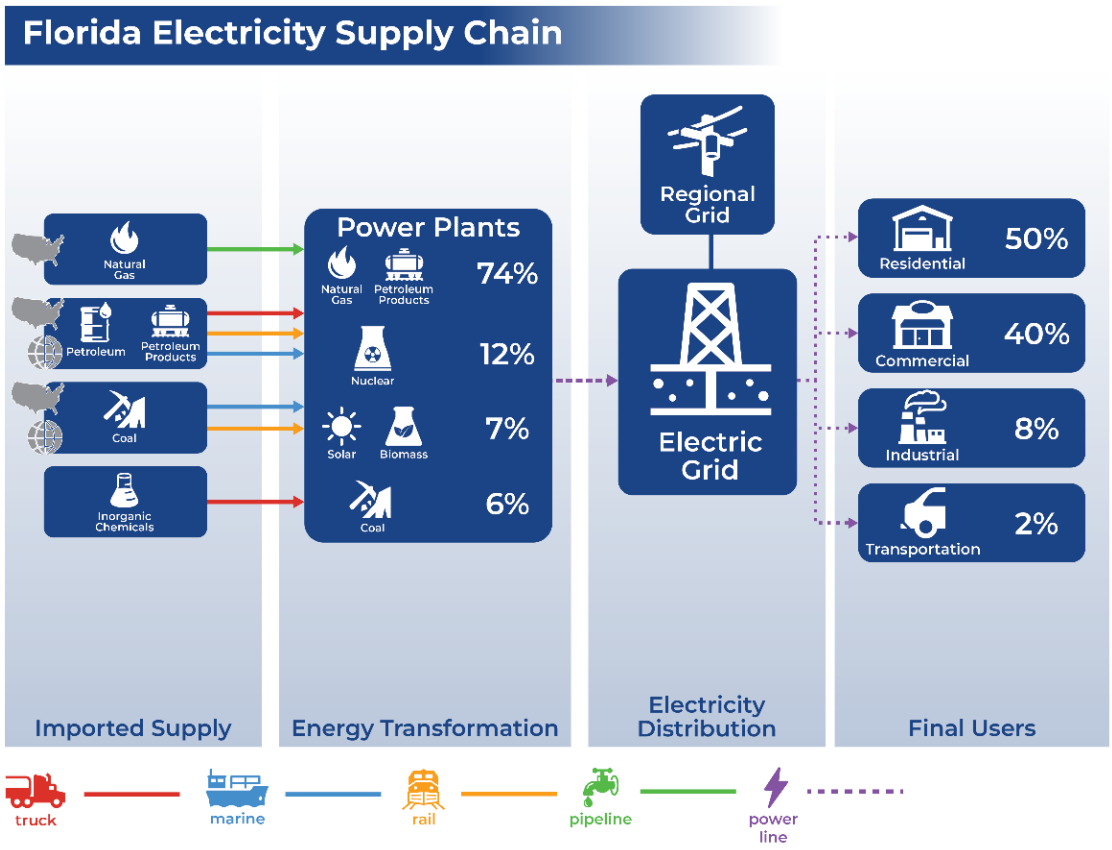
[27] U.S. EIA, Florida gasoline supply sources https://www.eia.gov/todayinenergy/detail.php?id=15651 accessed April 20, 2024.

[28] U.S. Nuclear Regulatory Commission, Florida. https://www.nrc.gov/info-finder/region-state/florida.html

electricity is generated in power plants, it flows into the electric grid through distribution or power lines. The grid includes electricity substations, transformers, and power lines that connect electricity producers and final users.[29]

The last stage in this supply chain occurs when the electricity is then distributed from the grid to final users. Florida's main electricity consumer is the residential sector, using 50 percent of electricity. This is followed by the commercial sector with 40 percent of the consumption. The remaining 10 percent is distributed amongst the industrial (8 percent) and the transportation sectors (2 percent).

FIGURE 16. ELECTRICITY MANUFACTURING SUPPLY CHAIN DIAGRAM



Source: Cambridge Systematics.

[29] U.S. Energy Information Administration. Electricity Explained.

Florida Refined Fuel Supply Chain Diagram

Florida's refined fuel supply chain diagram is shown in **Figure 17**. At the beginning of this section, it was explained that Florida imports fuel since it does not possess significant reserves of petroleum. Hence, the first step in the refined fuel supply chain (*imported supplies*) starts with inbound refined fuel being transported to ports and fuel terminals by vessels, tanker trucks and rail. The majority of gasoline supply arrives in Florida through Port Tampa Bay, Port Everglades, JAXPORT , and Port Canaveral.[30] Once in Florida ports and fuel terminals, refined fuel intra-flows are mainly moved by truck and pipeline.

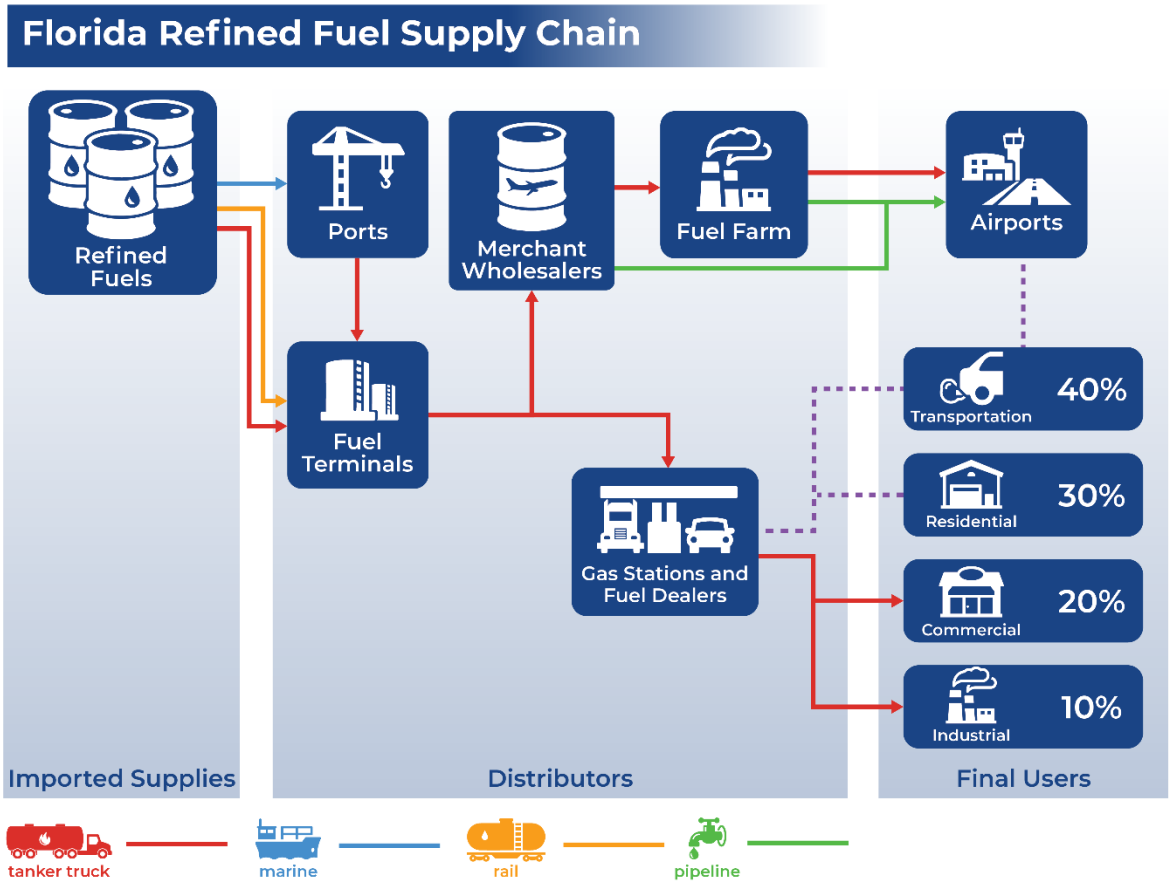
In the second step of the supply chain (*distributors*), refined fuels are distributed to gas stations, merchant wholesalers and fuel farms. Wholesalers supply jet fuel to fuel farms by pipeline and truck to distribute to airplanes. The distribution between fuel terminals and gas stations is conducted by tanker trucks.

The third and final stage in the refined fuel supply chain is the distribution of the fuel to *final users*. The transportation sector consumes most of the refined fuels (40 percent) that arrive to Florida due to its significant tourism industry. The residential sector follows transportation on refined fuel utilization (30 percent). The remaining refined fuel is mainly distributed among the commercial (20 percent) and industrial (10 percent) sectors.[26]

Some gasoline shipments arrive in Florida by both pipeline and truck. At a terminal in Bainbridge, Georgia, gasoline is transferred from the Colonial Pipeline system to a long-distance tanker truck for delivery to the Florida panhandle. Trucks and barges (moving by the Intracoastal Waterway) from nearby refineries in Alabama and Mississippi supply the rest of western Florida.

FIGURE 17. REFINED FUEL SUPPLY CHAIN DIAGRAM

[30] Florida petroleum product supply movements. U.S. Energy Information Administration, October 2022.



Source: Cambridge Systematics.