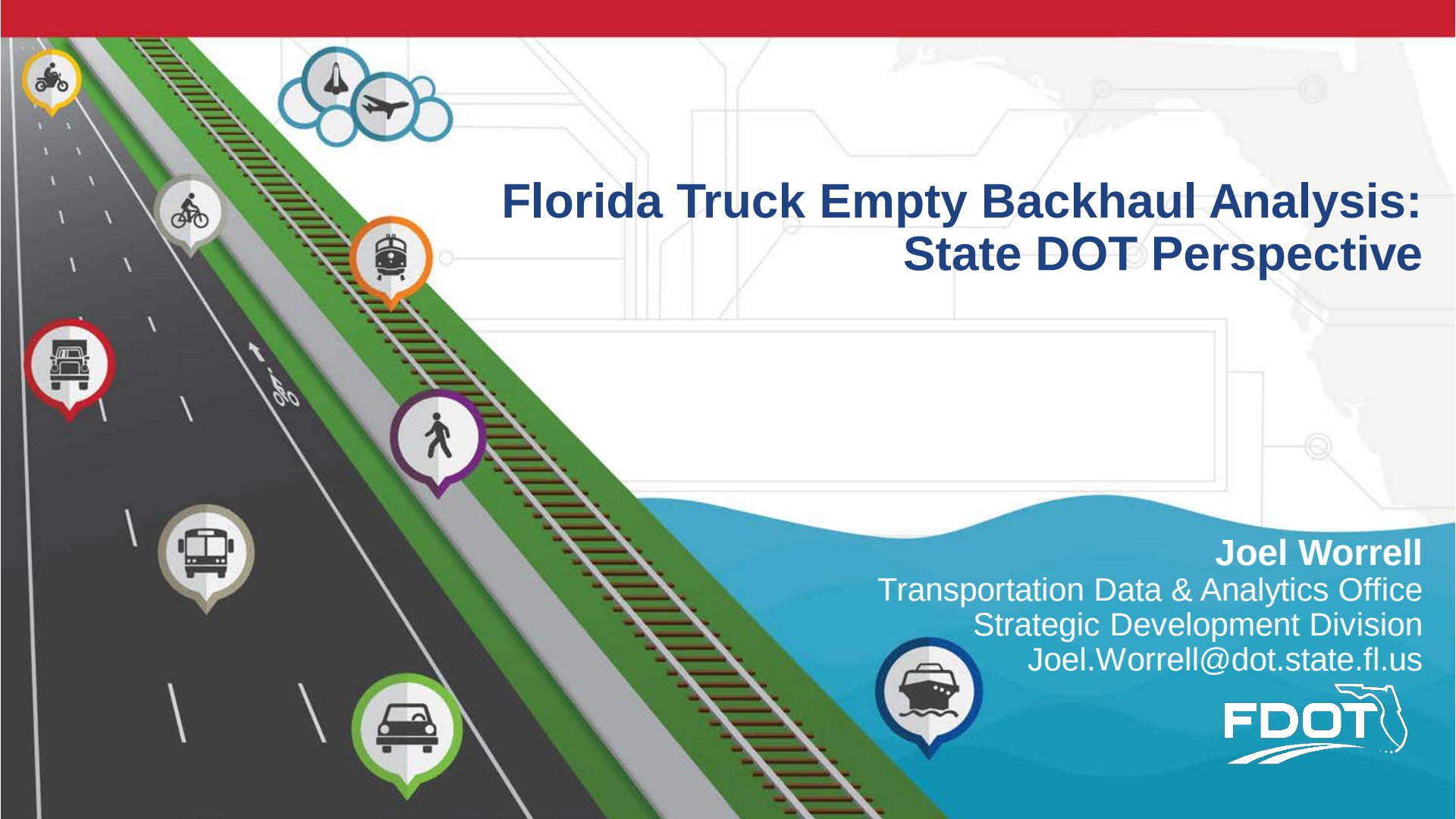

Florida Truck Empty Backhaul Analysis: State DOT Perspective

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FDOT

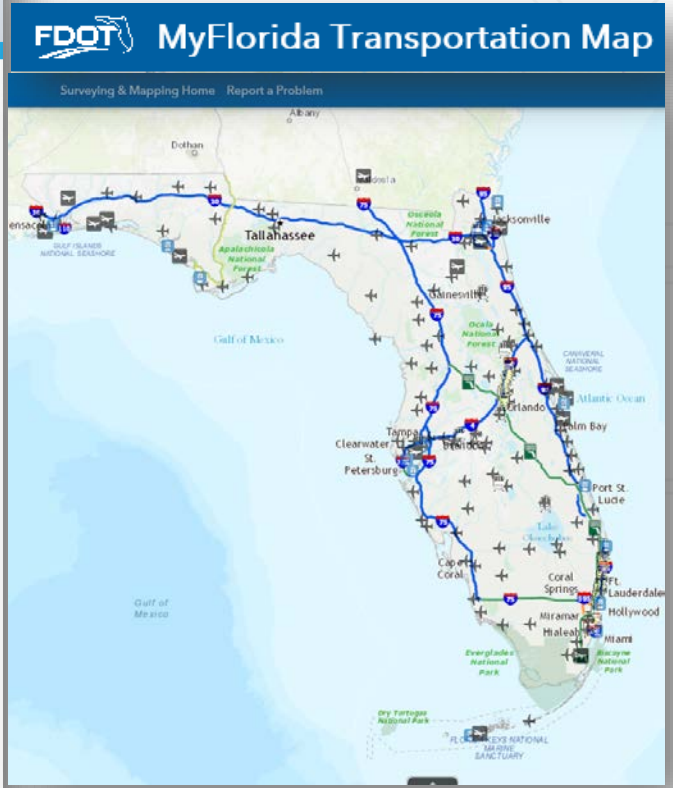
FLORIDA TRANSPORTATION FAST FACTS

GENERAL

20.5 M	people	112 M	visitors	53,625	square miles of land

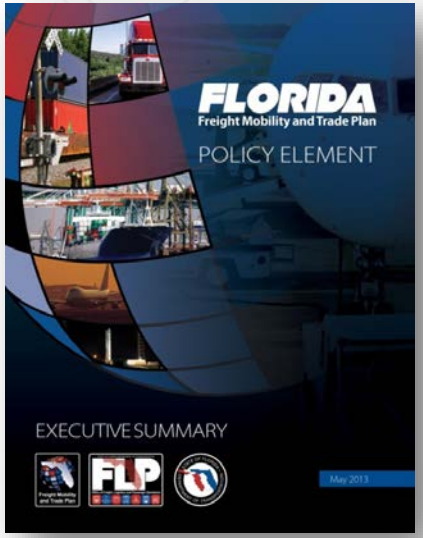
TRANSPORTATION SYSTEM		MOBILITY PERFORMANCE MEASURES	
HIGHWAY AND BRIDGE			
122,736	centerline miles of public roads	322.1 M	daily vehicle miles traveled on the SHS
12,107	centerline miles of State Highway System (SHS)	77%	reliable peak hour/peak period travel on freeways
4,688	centerline miles of Strategic Intermodal System (SIS)	5%	of the SHS centerline miles are heavily congested during peak hour
12,267	bridges, 6,858 maintained by FDOT	637 M	truck tons transported in Florida
18.2 M	registered motor vehicles	5.6 B	annual combination truck miles traveled on the SHS
TRANSIT			
31	urban transit systems	250.6 M	annual transit passenger trips
18	rural transit systems	56%	of Florida's population lives within a half-mile of fixed route transit
BICYCLE AND PEDESTRIAN			
7,438	miles of bicycle facilities on non-freeway SHS	75%	of non-freeway SHS have bike lanes, paved shoulders, or shared-use paths
3,417	miles of pedestrian facilities on urban non-freeway SHS	67%	of non-freeway SHS in urban areas have sidewalks or shared-use paths
		42%	of Florida's population lives within one mile of FDOT-monitored bike lanes and shared-use paths
PORTS (SEA/AIR/SPACE)			
20	commercial airports	78.1 M	annual aircraft passenger boardings
15	seaports	83%	of aircraft trips depart on time, annually
2	spaceports	15.5 M	annual cruise passengers
RAIL			
2,743	miles of mainline railroad track	63 M	annual rail passengers

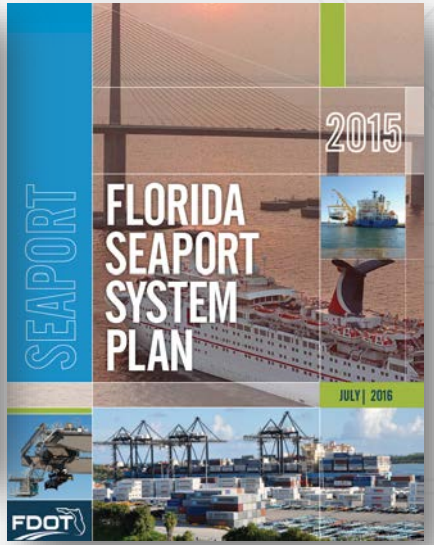
fdot.gov/planning/fastfacts.pdf

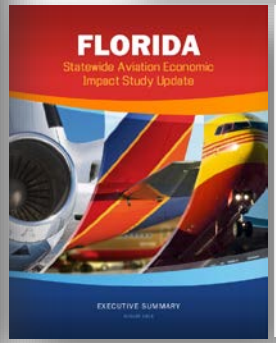


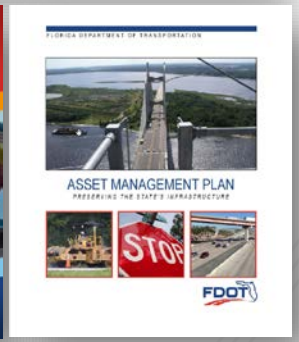
fdot.gov/agencyresources/mapsanddata.shtm

Multimodal Planning and Studies









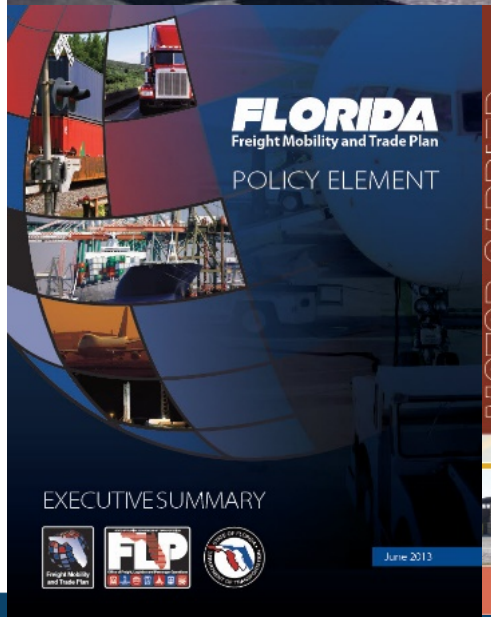
Data Governance to Data-Driven Decision Making

- **Maintain the Investment**
  - Develop a Multimodal Data System Program to Invest in Freight and Passenger initiatives
  - Integrate with Core Department Data Systems
    - Roadway Data, HPMS, Traffic, LRS
  - Maintain a Data Governance Framework

- **Multimodal Data System Program Goals**
  - Provide Consistent and Effective Access, Collection, Analysis, and Reporting of Multimodal Data.
  - Integrate Multimodal Data Resources in FDOT Operations and Planning Offices.
  - Coordinate Data Needs, Investments and Improvements.
  - Provide Training and Awareness of Data, Datasets, Analytics, Tools, and Models.

Project Motivation

- Systematically quantify Truck Empty Backhaul (TEBH) - objective assessment vs. anecdotal intel
- Anecdotal ‘evidence’ suggests **75%** of all trucks leaving the state are empty
- F.S. 334.044(33) (a) – establishes the Freight Mobility and Trade Plan (FMTP) that identifies “investments that capitalize on the empty backhaul trucking and rail market in the state”
- FMTP and Motor Carrier System Plan both rank TEBH as a major issue in Florida (3.8 / 5.0 average importance rating)



Study Objectives

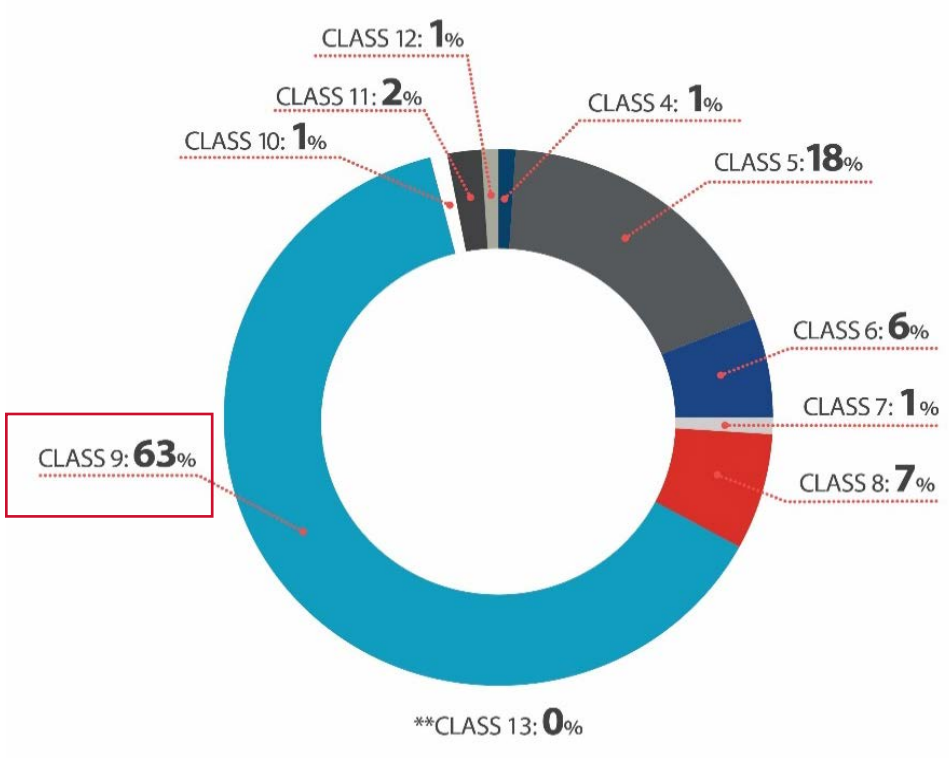
- Define Truck Empty Backhaul
- Develop a quantifiable methodology
- Analyze data and results
- Identify influencing factors
- Summarize findings and recommendations

Methodology

1) **Percent of Trucks per Vehicle Class**
   - Identify which class(es) the analysis should focus
   - FHWA Scheme F Class 9 (5-axle, combination trucks) – Primary vehicle class for long-hauls

2) **Empty and Full (GVW)**
   a) Empty = < 40,000 lbs.
   b) Full = > 60,000 lbs.

3) **Axle Weight Distribution**
   a) Cubed Out
   b) Partially Empty



All WIM locations within FL

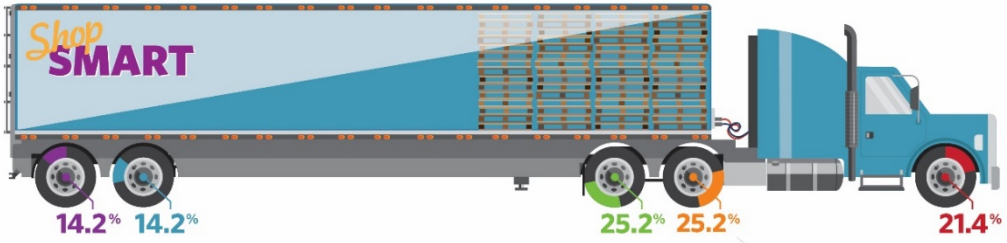
Methodology – Axle Weight Distribution

CUBED OUT: >40K, <60K

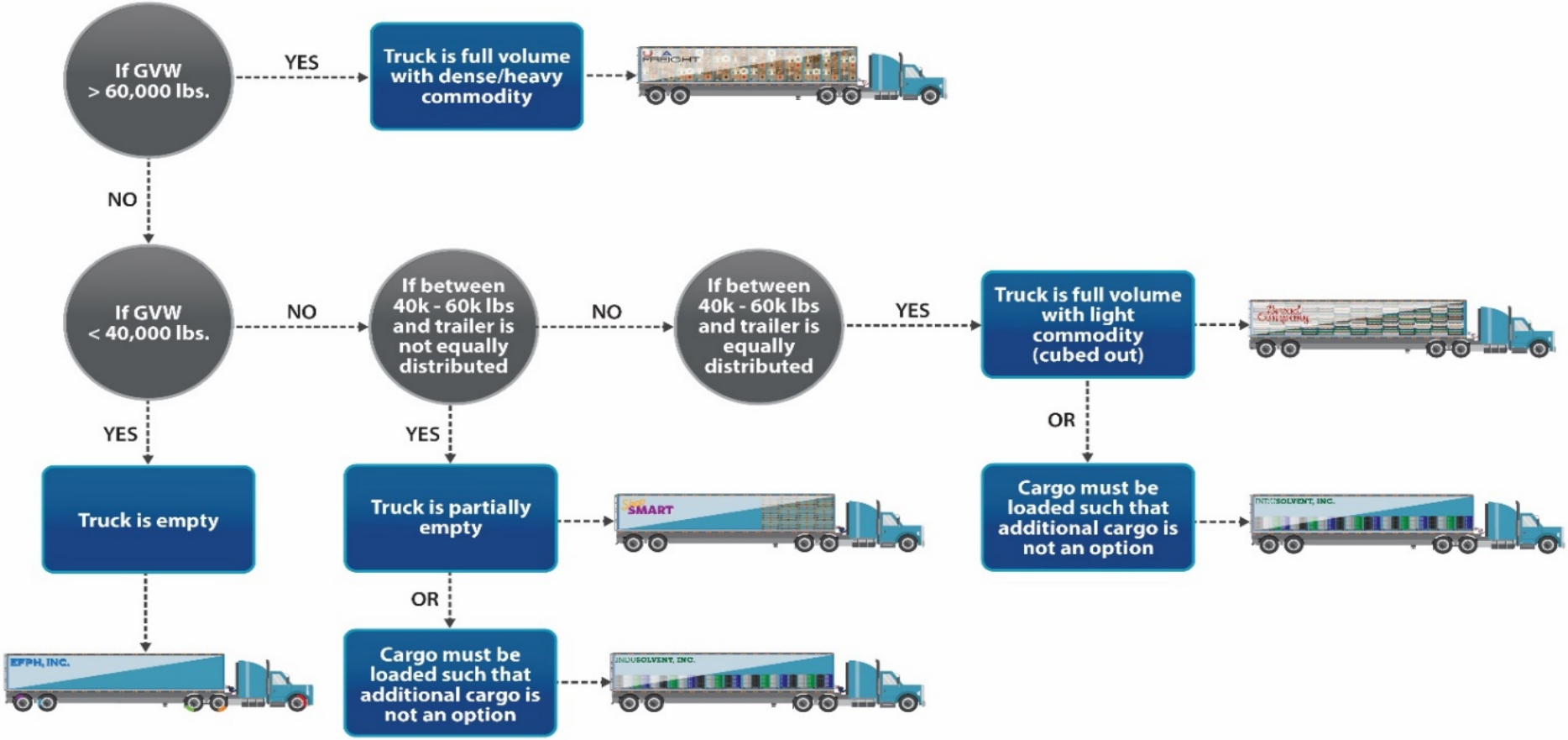
GVW: 53,040

PARTIALLY EMPTY: >40K, <60K

GVW: 58,280



Methodology

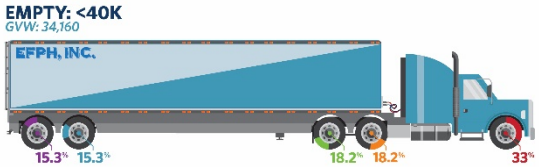


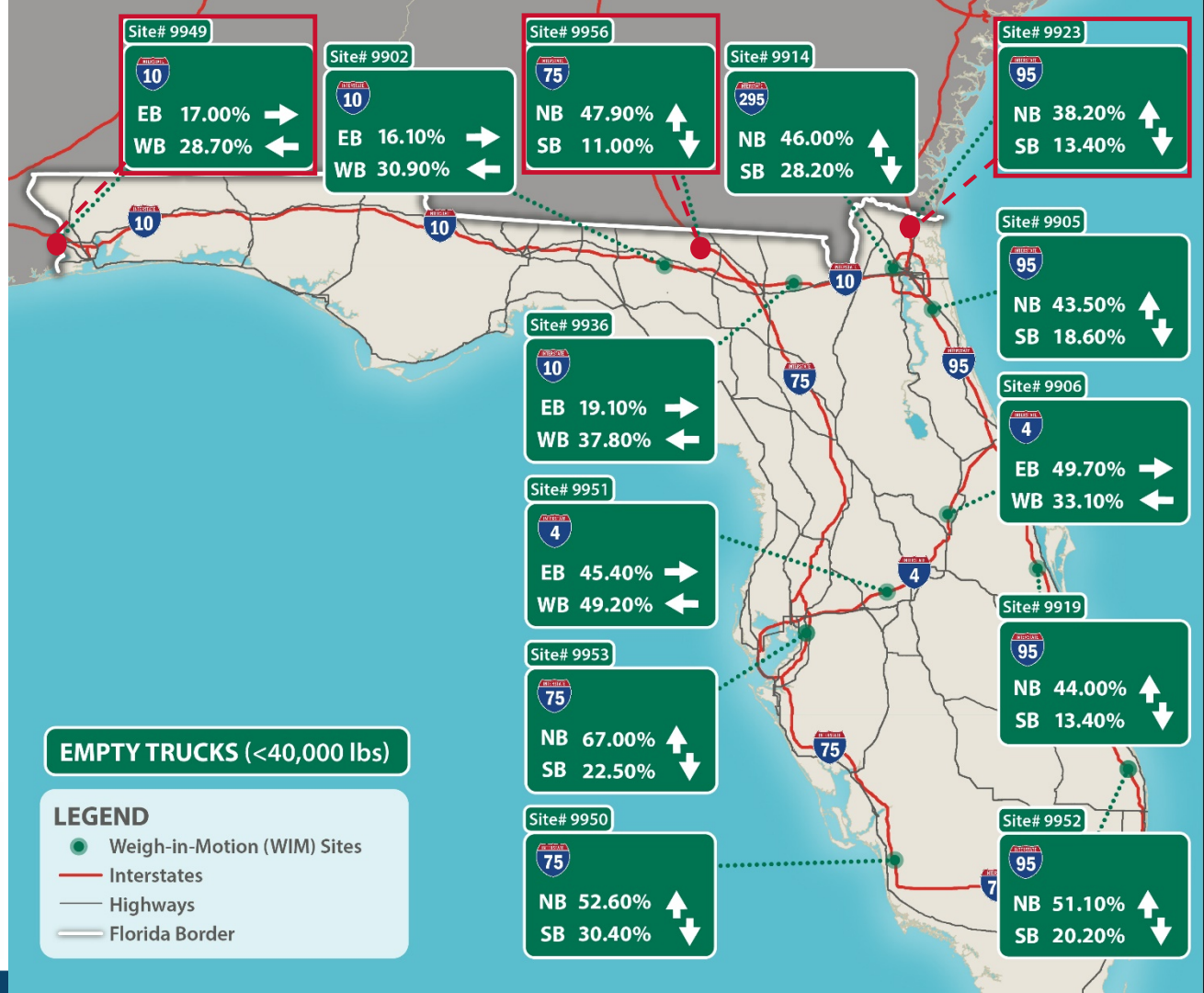
Data Prep & Analysis

- Data preparation – January 2015 through September 2017 (>100 million records, class 5+)
- Data validation – remove errors
- Use SPSS for analysis
  - Class 9 trucks
  - Interstate WIM sites

Findings - Empty Trucks

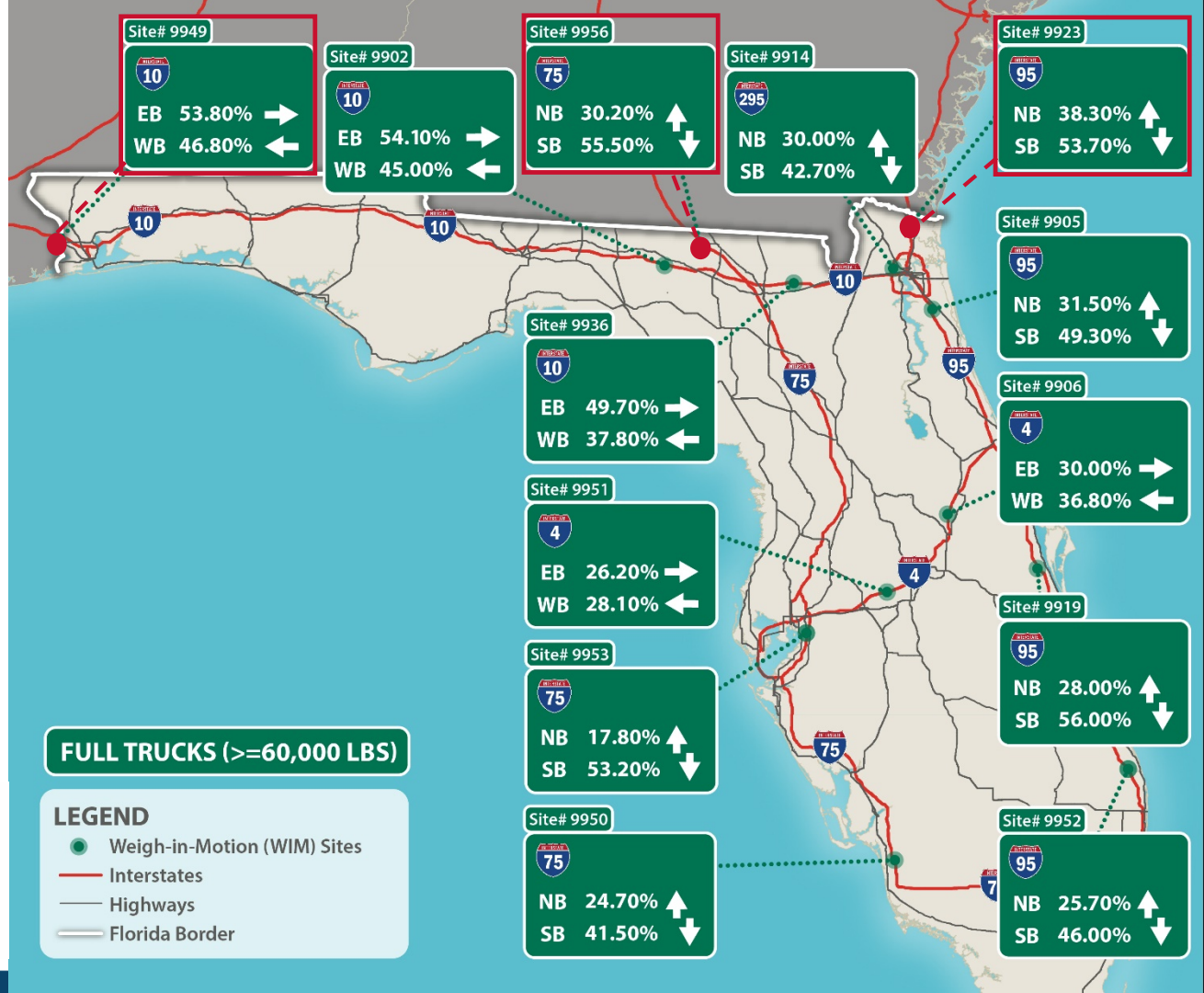
- The percentage of empty trucks leaving the state **ranges between 30% and 50%** depending on the corridor.
- Approximately 15% to 20% trucks entering Florida are empty.





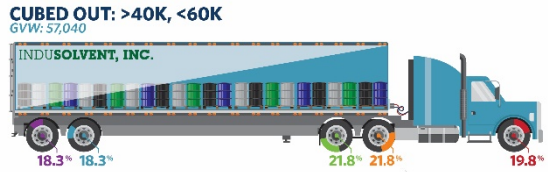
Findings – Full Trucks

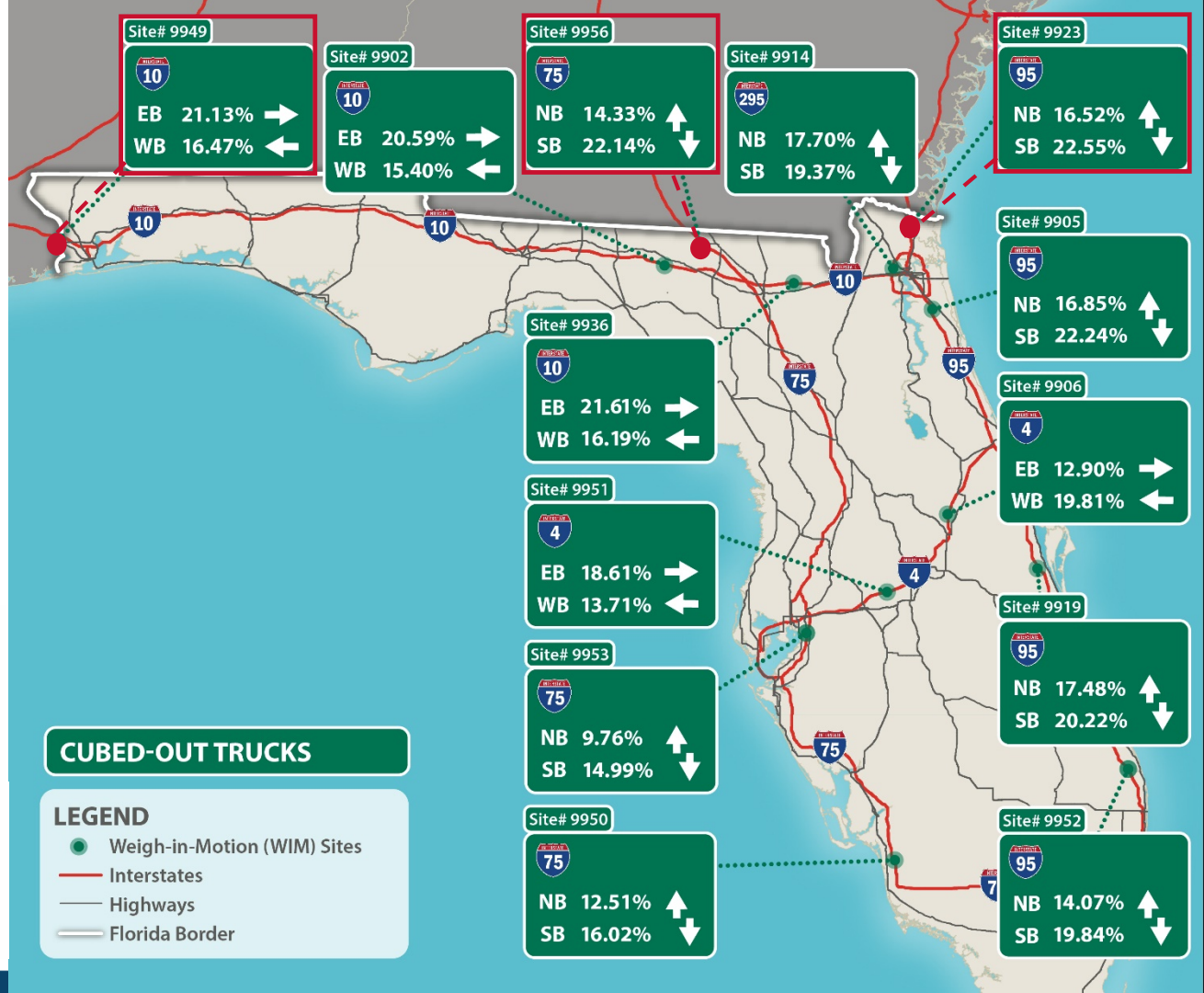
- Larger percentage of full trucks traveling into the state compared to trucks leaving the state.
- Validation of trade imbalance



Findings – Cubed Out

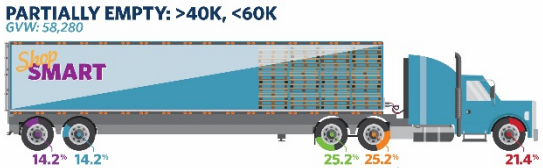
- Cubed out trucks make up nearly 20% of all truck traffic

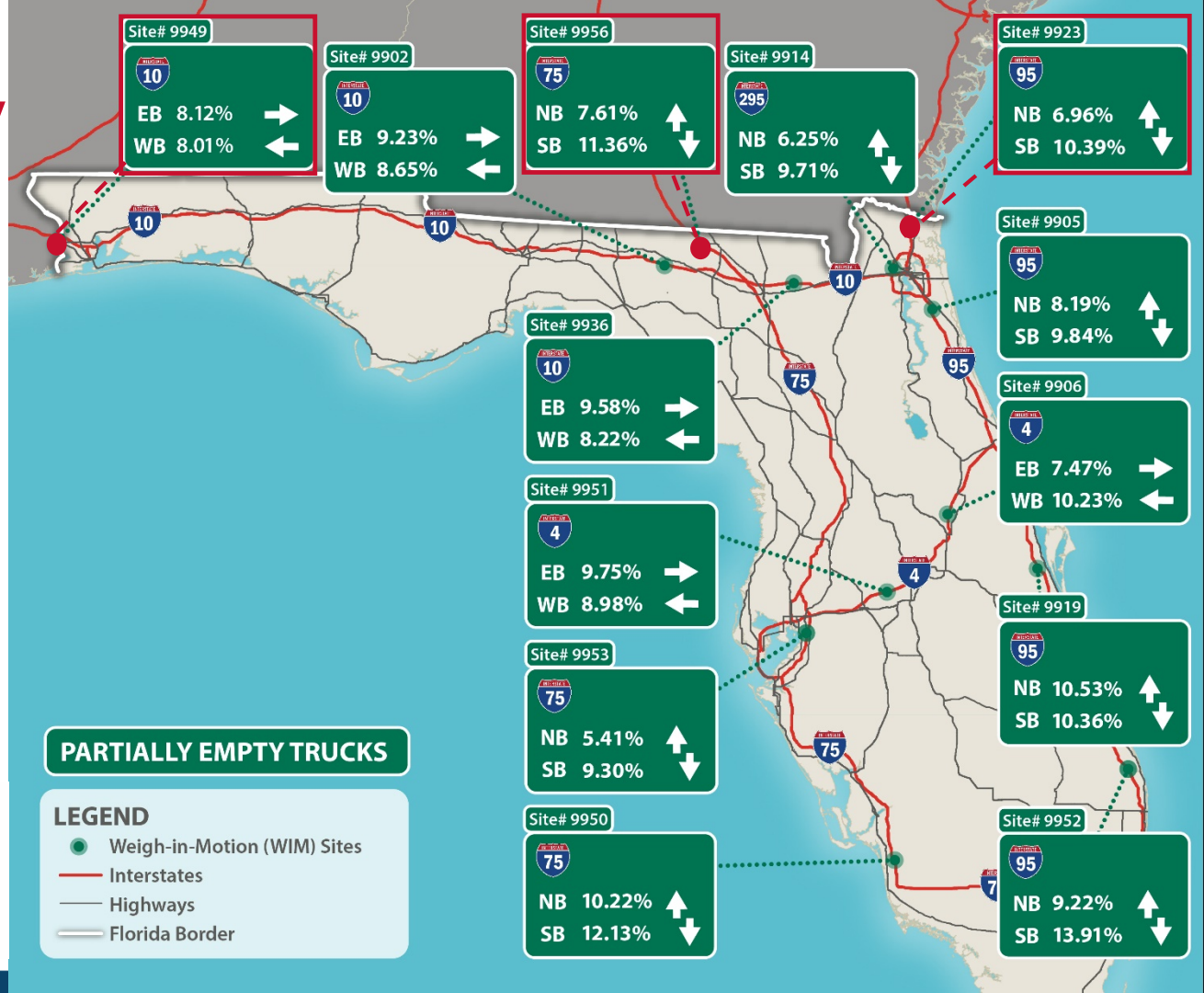




Findings – Partially Empty

- Partially empty trucks make up nearly 10% of all trucks
- Likely Causes:
  - LTL shippers
  - Private (dedicated) trucks returning empty pallets, etc.
  - Cargo cannot be mixed
  - High value goods that do not require additional cargo for a cost-effective trip



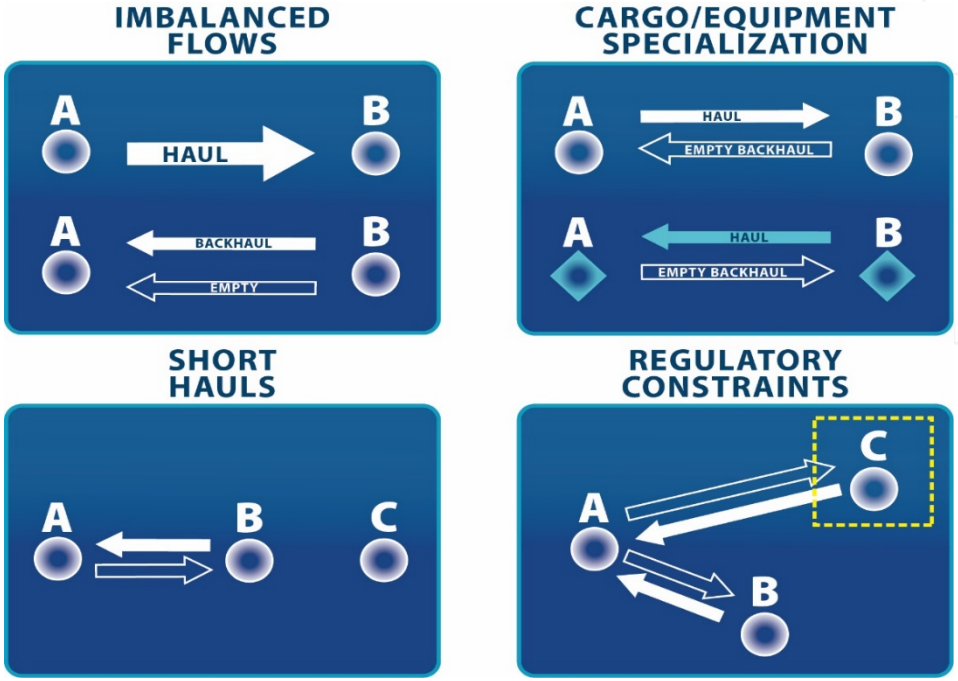


Factors Contributing to TEBH

Florida specific factors:

- 3rd most populous state in the nation (21M+)
- Geography – peninsula, not a regional hub
- Visitors (3M+ per day)
- Retirees
- Service sector economy – lack of manufacturing

Industry factors:

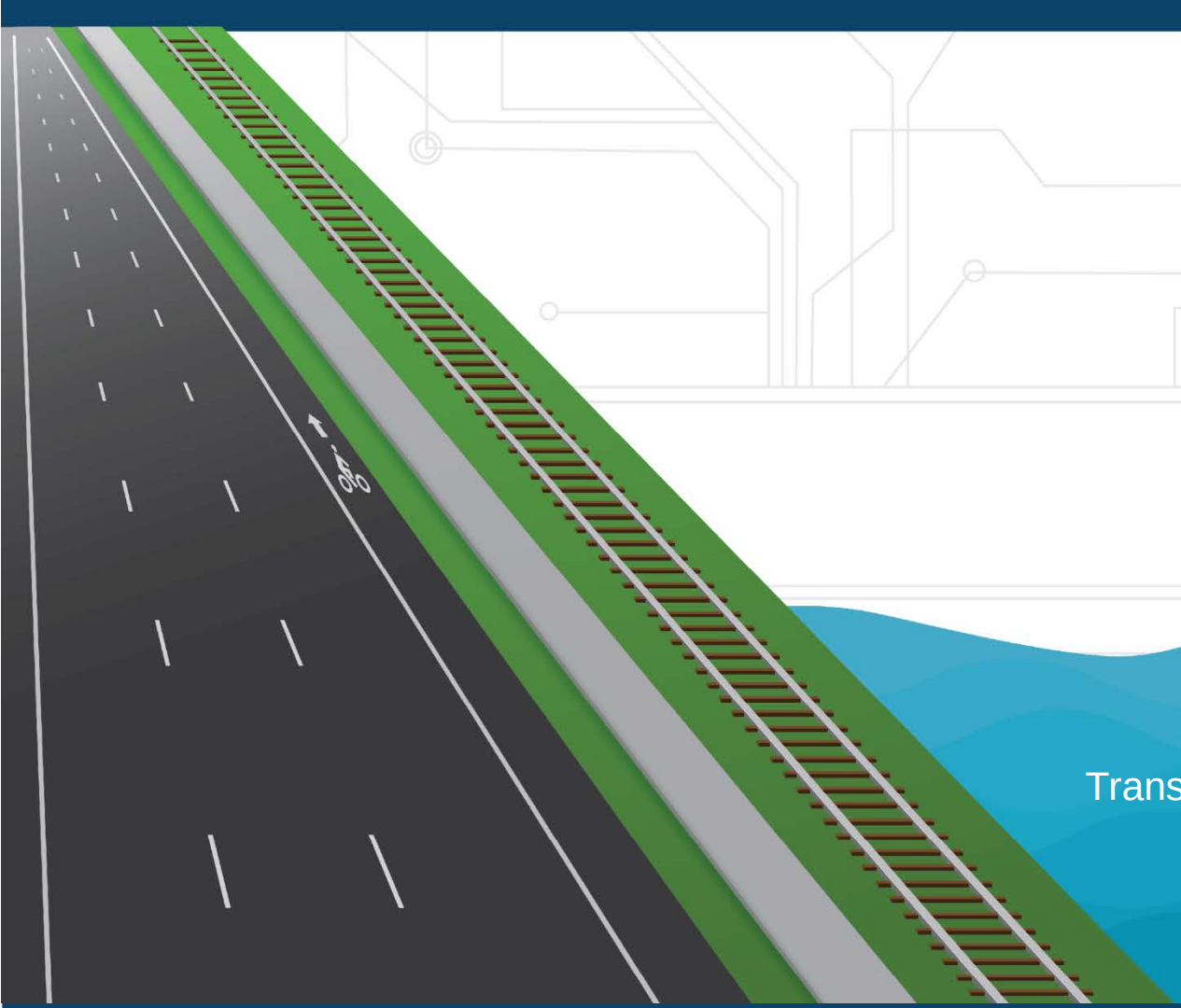


Imbalance Solutions

- Increase manufacturing industry
- More ‘transient’ cargo into FL seaports (imports) bound for areas north/west of FL
- Invest in projects facilitating outbound freight
- Develop more in-land ports
- Collapsible cargo containers
- Cost savings – automated trucks, driver assisted truck platooning, WIM “green light” program

Analysis Recommendations

- Include all freight modes in future analysis
- Align commodity datasets with industry data to better understand private sector perspective – supply chain optimization
- Leverages other freight data including both observed and estimated datasets
- Investigate opportunities to improve the robustness of the WIM data (bobtails in Class 6, additional field attributes (i.e., GVW/UL))
- Consider development of Florida Freight Commodity Survey to understand commodity flows at a micro-level



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Florida Statewide Model Freight Data

Presented By:
Thomas Hill
State Modeling Manager
Florida Department of Transportation

December 19, 2018

Outline

- **Measuring the economic impacts of freight transportation based on FreightSIM**
  - What does road freight transportation play in urban and regional economic development?
  - How do we quantify this role with economic modeling?
  - **Examples**
    - Port of Jacksonville Expansion Project
- **Freight Data Fusion**
  - FAF and Transearch

Florida Freight Economic Impact Tool

- Performs regional economic impact analyses
  - Based on FreightSIM output
- Economic analysis methodology is based on regional IO model
  - Core = freight demand combined with multi-sectoral economic model
    - Outputs converted into monetary values
    - Used as inputs for the regional economic model

Case Study: Port of Jacksonville

- Scenario: increase port cargo capacity by 30%
  - Base = 23.3 million tons
  - Modified: 33.3 millions tons
  - Divergence of truck freight to port freight
  - Conducted State and County (Duval) level analyses
  - Study Periods: 2017 to 2035

FreightSIM Output

Total VHT savings	Port capacity no change	Port capacity increase by 30%	VHT change
2035 output	No-Build Scenario	Built Scenario	
Statewide	125926432.3	125929187.3	-2755.9
Duval county	1702307.0	1725873.2	-393.1

Case Study: Port of Jacksonville

- Direct Freight Benefits:
  - VOT = $23/hr
    - Statewide Savings = $23*365*2,755.9
      - $23,135,780.50
    - County Level Savings = $23*365*393.1
      - $3,300,074

  - Net Present Value: 3% (converting VHT to monetary values, compounded FY)
- Estimated Savings:

Net present value (NPV)	System VHT change savings	Direct annual truck travel time savings for 2035	NPV
Base year 2017			
Statewide	2755.9	$ 23,135,780.5	$25,687,981.2
Duval county	393.1	$ 3,300,074.5	$3,664,118.95

Case Study: Port of Jacksonville

- Economic Impact Analysis
  - IMPLAN
    - Economic impacts from estimated freight travel times
    - North American Industry Classification System (NAICS) 2-digit
  - FreightSIM + IO Economic Model

Statewide Savings:

Employment: increase of 364 workers
Income: + $16 million (20 year period)
Freight transportation = highest share of increases
Total Savings (20 yrs) = $25 and $56 million

County Level Savings:

Employment: increase of 37 workers
Income: + $2.2 million (20 year period)
Freight transportation = highest share of increases
Total Savings (20 yrs) = $3.2 and $6.2 million

Case Study: Port of Jacksonville

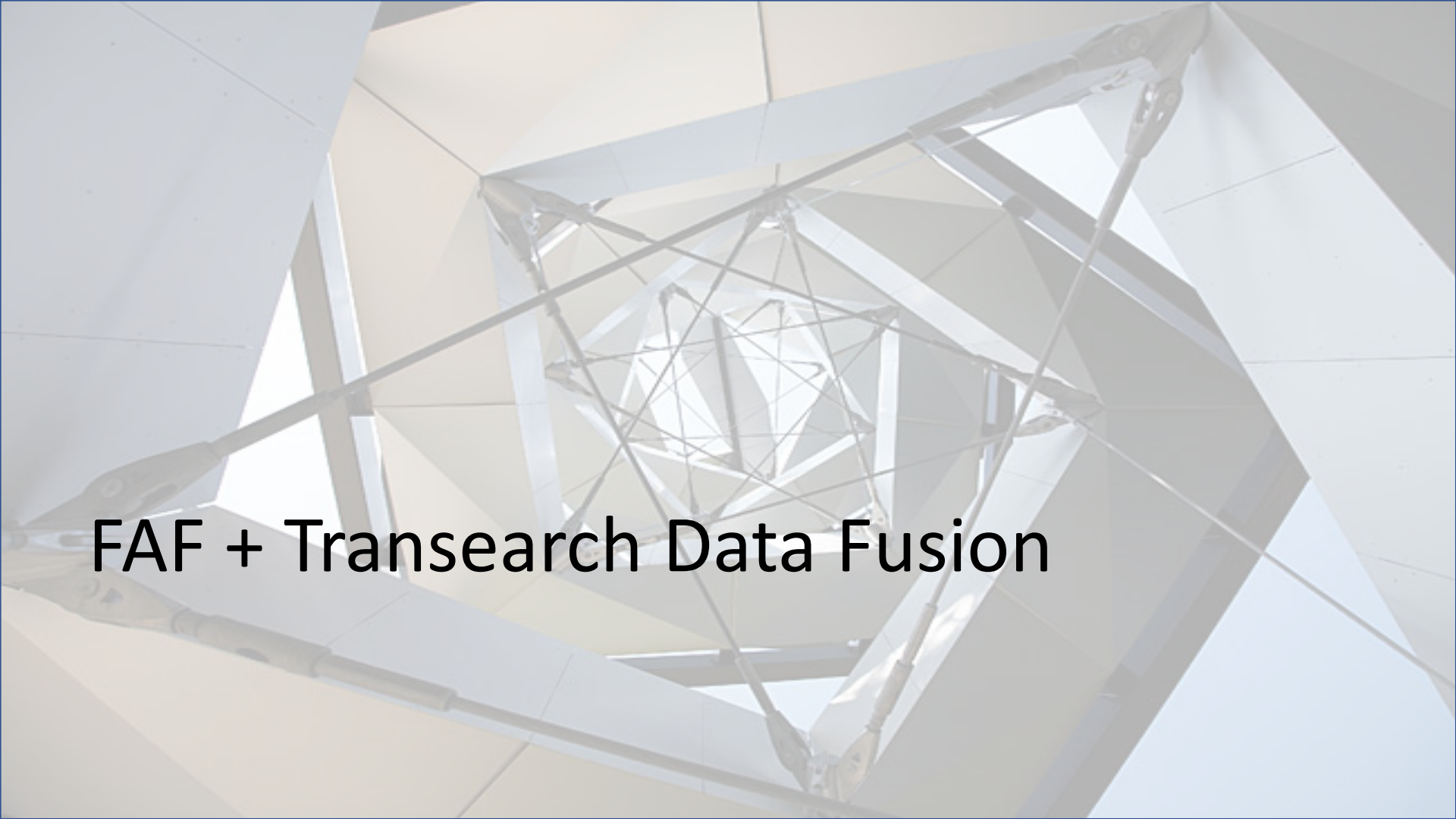
State Level Impacts

Description	Employment	Labor income	Value added	Sectoral Output
Total	364.9	$16,962,229	$25,559,747	$56,013,209
11 Ag, Forestry, Fish & Hunting	0.7	$22,856	$35,745	$64,599
21 Mining	0.3	$6,063	$9,016	$38,671
22 Utilities	0.5	$58,313	$259,864	$565,115
23 Construction	2.6	$111,817	$184,622	$422,687
31-33Manufacturing	3.6	$245,260	$416,142	$1,445,808
42 Wholesale Trade	7.8	$645,344	$1,252,443	$1,966,928
44-45 Retail trade	19.7	$657,030	$1,055,057	$1,591,814
48-49Transportation & Warehousing	26.6	$1,573,285	$2,385,148	$5,072,952
Freight Truck	172.4	$7,569,357	$9,203,516	$26,253,486
51 Information	2.8	$247,662	$562,948	$1,231,602
52 Finance & insurance	19.5	$1,164,505	$1,703,802	$3,962,554
53 Real estate & rental	16.0	$322,600	$3,108,411	$4,694,007
54 Professional-scientific & tech svcs	11.0	$752,812	$923,510	$1,564,265
55 Management of companies	3.6	$365,742	$471,392	$802,044
56Administrative & waste services	23.2	$777,870	$964,253	$1,528,512
61 Educational svcs	2.9	$112,269	$118,951	$188,421
62 Health & social services	17.2	$988,627	$1,096,961	$1,764,958
71 Arts- entertainment &recreation	3.7	$122,440	$194,023	$316,562
7Accommodation & food services	12.4	$322,606	$521,168	$864,525
81 Other services	12.1	$444,623	$505,967	$1,048,028
92 Government & non NAICs	6.2	$451,149	$586,807	$625,673

Case Study: Port of Jacksonville

County Level Impacts

Description	Employment	Labor income	Value added	Sectoral Output
Total	36.9	$2,222,949	$3,185,051	$6,225,578
11 Ag, Forestry, Fish & Hunting	0	$87	$159	$277
21 Mining	0	$95	$200	$529
22 Utilities	0.1	$11,979	$36,275	$67,163
23 Construction	0.2	$10,809	$18,332	$40,180
31-33 Manufacturing	0.1	$10,431	$21,311	$63,977
42Wholesale Trade	0.8	$63,171	$124,223	$197,056
44-45 Retail trade	2.1	$67,946	$107,686	$164,774
48-49 Transportation& Warehousing	2.6	$181,482	$250,397	$491,511
Freight Truck	18.4	$1,248,984	$1,545,426	$3,368,076
51 Information	0.3	$29,073	$48,310	$105,319
52Finance& insurance	1.9	$142,732	$216,068	$442,337
53 Real estate & rental	1.5	$29,599	$286,900	$438,521
54 Professional- scientific & tech svcs	1	$66,077	$80,932	$136,559
55 Management of companies	0.3	$31,166	$40,201	$65,489
56 Administrative & waste services	2.2	$83,582	$104,406	$150,376
61Educational svcs	0.3	$10,947	$11,595	$19,185
62 Health & social services	1.7	$109,384	$120,305	$193,730
71Arts-Entertainment & recreation	0.4	$11,732	$17,333	$29,895
72 Accommodation & food services	1.3	$29,163	$47,787	$83,276
81 Other services	1.2	$43,066	$49,576	$105,600
92 Government & non NAICs	0.5	$41,445	$57,629	$61,749



FAF + Transearch Data Fusion

Freight Analysis Framework (FAF)

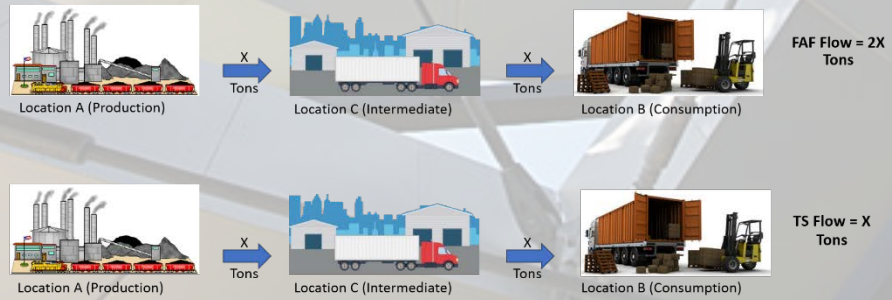
- A derivative from CFS which is freely available to the public
- Provides annual freight flows (by weight, value and mode) for **43** commodity types classified by Standard Classification of Transported Goods (SCTG 2-digit) code
- Very coarse spatial resolution – 132 domestic zones and 8 foreign zones
- The baseline year for current FAF data (FAF4) is 2012
- Includes forecasts on freight flows between 2015 and 2045 at a 5-year interval

Transearch (TS)

- A proprietary product developed by IHS Global Insight
- The database is constructed from various commercial and public sources
- The algorithm used to generate the final data product is not publicly available
- Freight flows are reported by commodity type based on the Standard Transportation Commodity Code (STCC) in more than **500** categories
- Fine spatial resolution – county level
- Expensive to acquire
- Data for future years is available till 2040

Major Differences – FAF and TS

- FAF and TS provide annual commodity flows in the US
- Variability in data collection mechanism employed
  - FAF relies on processing commodity flow data (such as CFS 2012)
  - TS uses various data sources to generate county level flows using a proprietary algorithm
- Variability in the representation of commodity flows
  - FAF flows represent actual transportation network flows
  - TS flows represent production-consumption commodity flows



The Idea

- TS flows provide production consumption (PC) trends at a county level
- If we can find paths for these PC flows on the network then we can generate the network flows (analogous to the FAF flows)
- However, the path flows will still be at a county level
- By, appropriately aggregating these generated path flows we can compare to the FAF flows
- The fusion algorithm is based on this concept

The Idea

- The challenge is how to link them – we use a fractional split approach that partitions PC flows onto each path
- Theoretically we could have a large number of paths feasible - however, for practical purposes we only consider direct paths and one-hop paths i.e. one intermediate county stop

Math Happens …

- Let, y_{ij} represent the natural logarithm of the actual TS flow, and $\hat{y}_{ij}$ the estimated TS flow. The log-linear model takes the following form:

$$y_{ij} = \beta X_{ij} + \varepsilon_{ij}$$

where, X_{ij} are the independent variables for the specific county pair $i - j$ and β represents the corresponding vector of parameters

- The likelihood for the estimation takes the following form:

$$LL_{TS_{i,} - \frac{\emptyset(\frac{\hat{y}_{ij} - y_{ij}}{\sigma_{TS}})}$$

where, $\emptyset$ represent t
the standard normal
standard deviation of

The probability for each path determined i
a random utility approach is as follows

$$P\left(k_{ij}\middle|x_{ij}^{k}\right) = \frac{\exp(\cup_{ij}^{k})}{\sum_{l=1}^{K}\exp(\cup_{ij}^{l})}$$

$\cup_{ij}^{k}$ represent utility for the k^{th} path between *i* and *j*; α represents the ve
parameters for path utility and
$P\left(k_{ij}\middle|x_{ij}^{k}\right)$ represents the probabilit
the k^{th} path between *i* and *j*

- Based on the path flow probability the actual flow assigned to each path is:

$$h_{ij}^{k} = \hat{y}_{ij} * P(k_{ij}|x_{ij}^{k})$$

- The path flow estimation leads to the estimation of the link flows *V*

$$V = Ah$$

- Given that these flows are available at the county level, we need to aggregate them to a coarser level to compare the flows to observed FAF flows
- The aggregation is achieved over Origin (*O*) and Destination (*D*) FAF as

$$\hat{F}_{OD} = \sum_{l \in O, q \in D} V_{lq} \quad \forall\, O, D \in \Theta$$

where *l*, *q* represent counties in *O* and *D* respectively; where Θ is set of all FAF zones

- The allocation is obtained for an OD pair by apportioning the error to all FAF zones involved over the entire path set for that OD pair

$$LL_{FAF}{}^{k_{ij}} = \frac{\sum_{r=1}^{n} LL_{FAF}{}^{r}}{n}$$

where, n is the number of link in the path $k = \begin{cases} 1, & for\ direct\ path \\ 2, for\ one - hop\ paths \end{cases}$

- To normalize for the number of counties in the FAF zone, we employ

$$LL_{FAF}{}^{OD,Norm}{}_{i,j} = \frac{\sum_{s=1}^{N} LL_{FAF}{}^{k_{ij}}}{N_C}$$

where, N_c is the number of county pairs in the OD FAF region pairs

Finally, the joint log-likelihood is provided by the sum of log-likelihood for FAF and TS flow

$$LL_{total\ i,j} = \sum_{i,\,j} (LL_{TS_{i,j}} + LL_{FAF}{}^{OD,Norm}{}_{i,j})$$

Data Preparation

- The commodity types reported in the datasets were based on two different commodity classification systems
  - we consolidated the different commodity types into 13 comparable commodity types

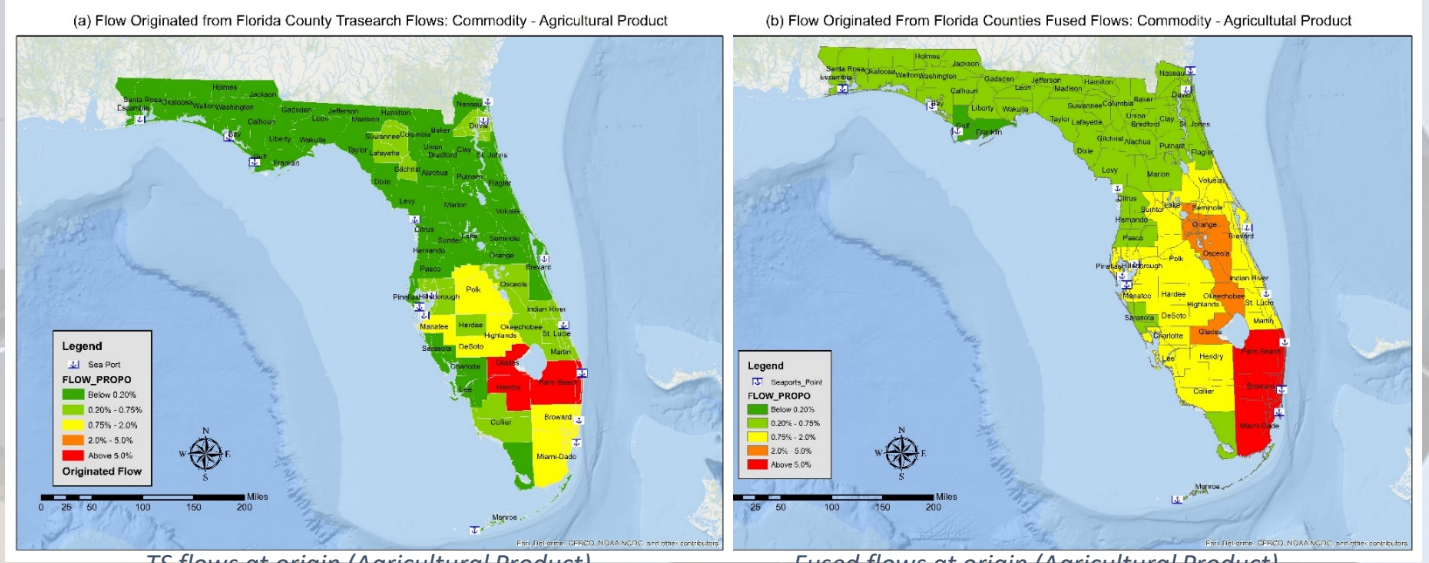
Commodity Types		Within FL All mode			With Ext Zones All mode		
		TS Flow (million tons)	FAF4 Flow (million tons)	Ratio (FAF4 flow/TS flow)	TS Flow (million tons)	FAF4 Flow (million tons)	Ratio (FAF4 flow/TS flow)
1	Agricultural Products	17.151	34.258	1.997	33.296	46.237	1.389
2	Minerals	71.648	205.172	2.864	90.733	224.645	2.476
3	Coal**	-	-	-	19.518	15.286	0.783
4	Food	12.398	29.743	2.399	39.307	53.144	1.352
5	Nondurable Manufacturing	0.860	5.140	5.977	7.024	10.734	1.528
6	Lumber	5.579	20.184	3.618	15.549	26.403	1.698
7	Chemicals	6.330	12.481	1.972	25.905	36.693	1.416
8	Paper	3.140	2.952	0.940	11.241	12.514	1.113
9	Petroleum	14.567	61.644	4.232	51.659	113.819	2.203
10	Other Durable Manufacturing	5.175	13.029	2.518	23.308	30.246	1.298
11	Clay and Stone	24.377	40.188	1.649	35.305	45.836	1.298
12	Waste	7.600	29.193	3.841	11.881	40.926	3.445
13	Miscellaneous Freight and Warehousing	53.629	14.569	0.272	78.667	19.813	0.252
Total		**222.454**	**468.554**	**2.106**	**443.392**	**676.296**	**1.525**

Validation

- The ratios of the fused flows with TS flows for both commodities were found to be of the same order as is expected for a fusion exercise

FCC	Description of Flow	Mean (Thousand Tons)	Std. Dev. (Thousand Tons)	Total (Million Tons)	No of Observations	FAF4 vs TS Ratio	Fused Link flows vs TS Ratio
Agricultural Products	TS County to County Flow	4.209	179.222	17.130	4070	2.000	1.445
	Estimated County Level Link Flow	5.514	22.105	24.752	4489		
Food	TS County to County Flow	4.990	35.063	12.210	2447	2.400	1.624
	Estimated County Level Link Flow	4.417	37.167	19.830	4489		

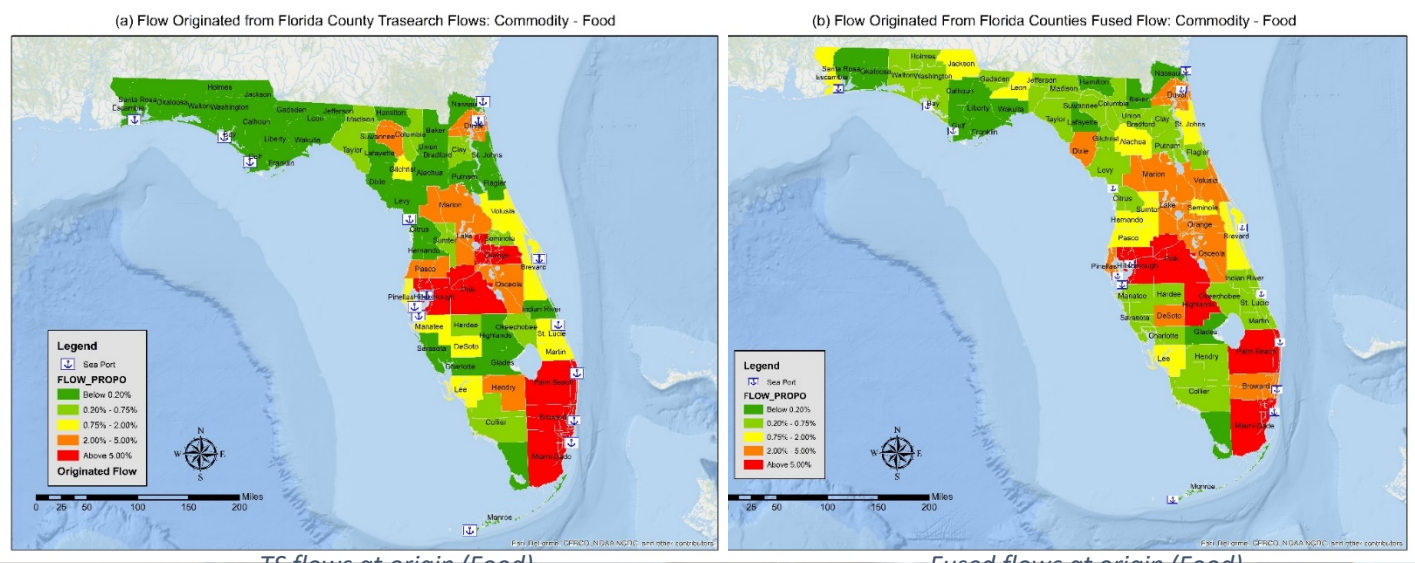
Validation



TS flows at origin (Agricultural Product)

Fused flows at origin (Agricultural Product)

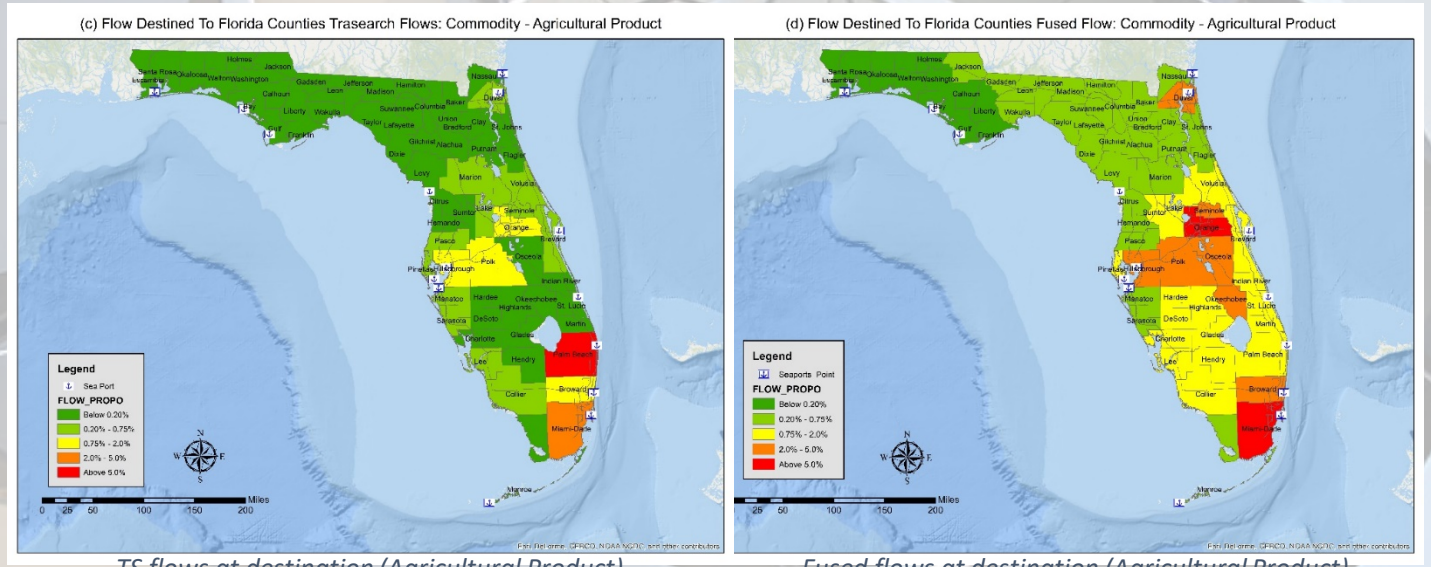
Validation



TS flows at origin (Food)

Fused flows at origin (Food)

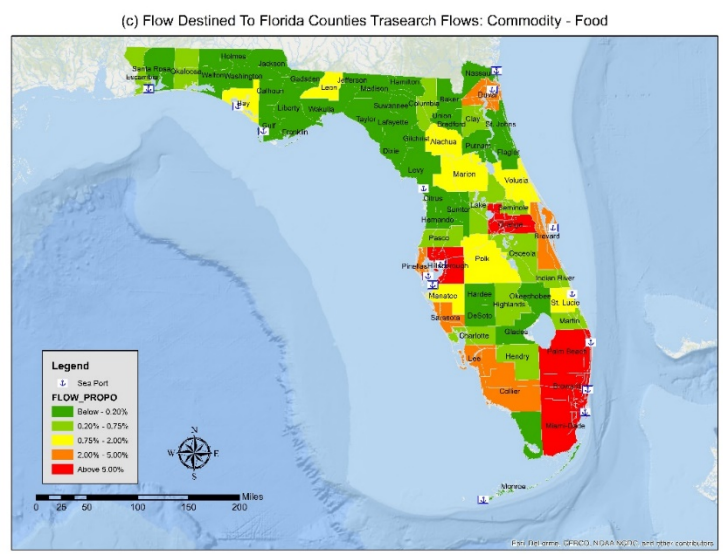
Validation



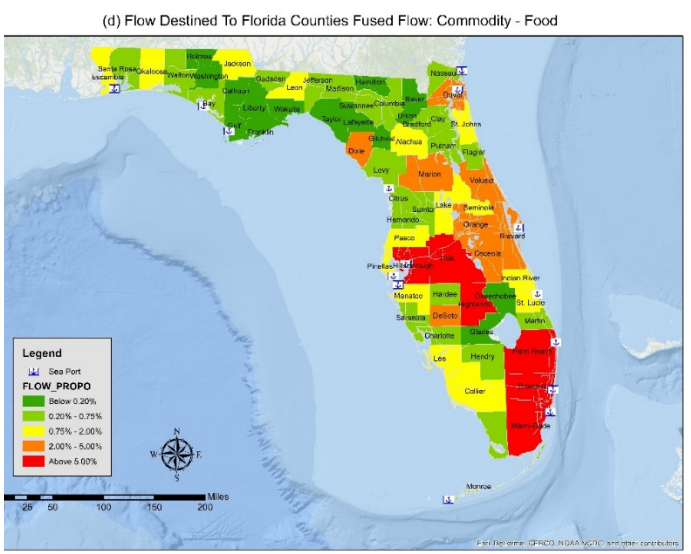
TS flows at destination (Agricultural Product)

Fused flows at destination (Agricultural Product)

Validation

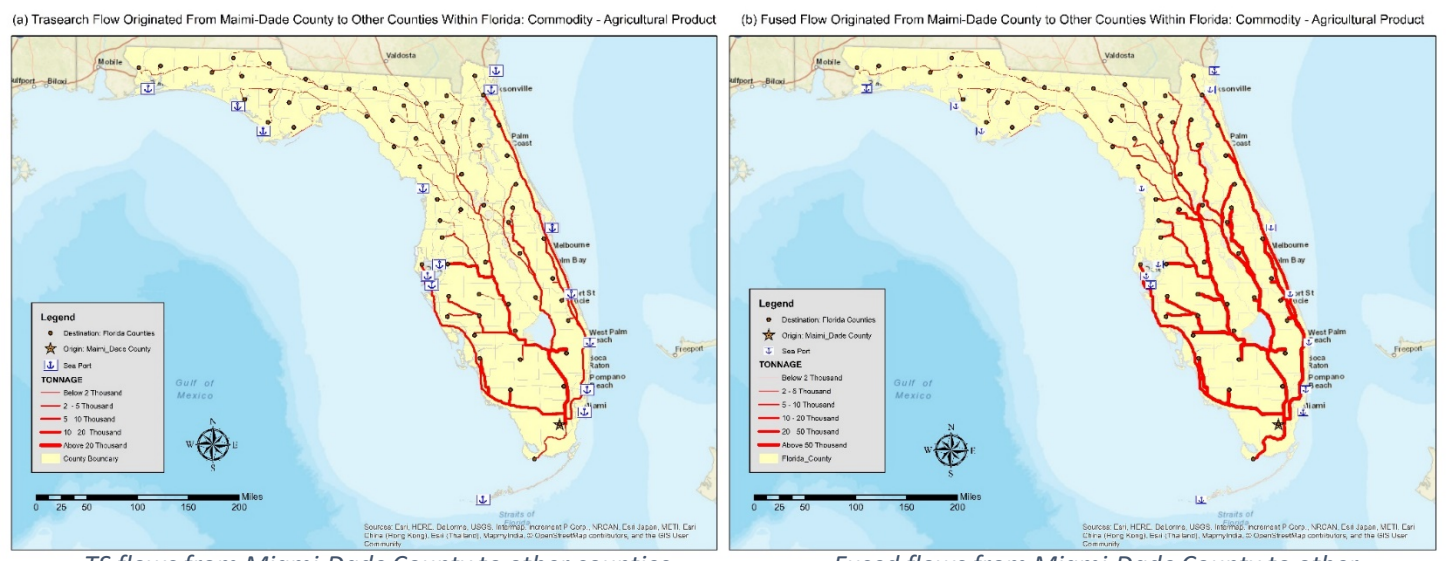


TS flows at destination (Food)



Fused flows at destination (Food)

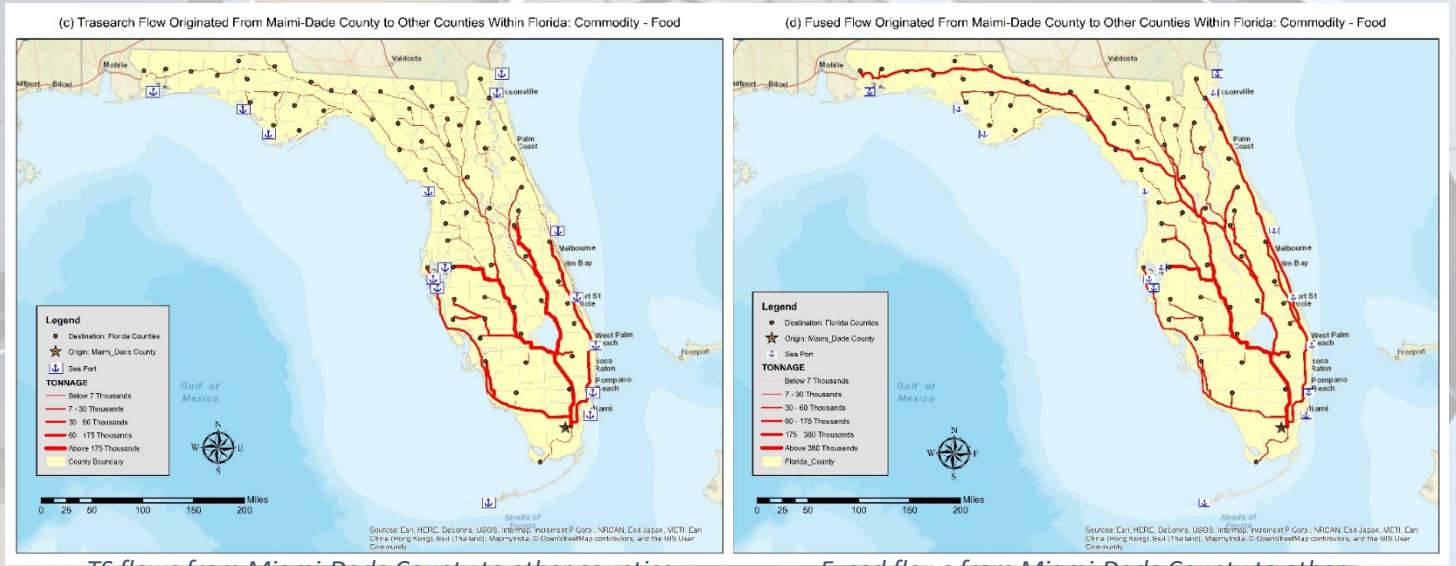
Validation



TS flows from Miami-Dade County to other counties : Agricultural Product

Fused flows from Miami-Dade County to other counties : Agricultural Product

Validation



TS flows from Miami-Dade County to other counties : Food

Fused flows from Miami-Dade County to other counties : Food

FSUTMSOnline.net

Thomas Hill
Statewide Modeling Manager
Forecasting And Trends Office

Freight Data for

County Freight Overviews

FMO
Freight & Multimodal Operations

Freight & Multimodal Operations (FMO)

Who We Are

Our office plays a critical role in meeting the challenges of continuing population growth and a rapidly diversifying economy, while aiming to **improve the efficiency of goods-movement** throughout the state of Florida.

The FMO Strategic Focus is to achieve success through teamwork and efficiency by means of removing **institutional, infrastructure** and **funding bottlenecks** to build a well-connected, reliable and safe multimodal network.

What We Do

On the rail side, we perform rail safety inspections, fund priority crossing signal improvements and capacity improvements, eliminate corridor hazards, conduct technology evaluation and research, provide crossing inventory and quality assurance, and consistently seek out projects to promote safety and awareness.

On the motor carrier side, we facilitate efficient truck flows on highways, ensure access to freight hubs through the "last mile", address intermodal access between trucks and other modes, and overall, balance safety and efficiency.

Tell the Freight Story

Objectives

- FDOT teamed up with the Florida Chamber of Commerce, Enterprise Florida, and CareerSource Florida
- Intent was to showcase combined resources on a series of brochures on Florida's freight infrastructure and commodity movements
- Target audience was public administrators, private corporations, and the general public

Contents

Each brochure includes:

- Interesting facts
- Fastest growing industries
- Largest employment sectors
- Major private employers
- Key transportation facilities
- Top import and exports
- Top trading partners
- Unique local photographs
- An illustrative map
- A general discussion on Florida's trade and economic initiatives
- Political and administrative contacts

Hernando County

FREIGHT & LOGISTICS OVERVIEW

COUNTY SEAT	LARGEST CITY	AREA	POPULATION	POPULATION GROWTH RATE
Brooksville, FL	Brooksville, FL	589 square miles	172,778	32.1% (2000-2010)

Primary Economic Development Contact: http://www.hernandobusiness.com

- Hernando County is home to the largest Civil War reenactment in Florida. Over 3000 Confederate and Union soldier re-enactors recreate the famous "Brooksville Raid" of 1864. The modern day re-enactment delivers a visual picture of what life was like during the Civil War.
- Expansion at the Hernando County Airport includes a new $2.5 million air traffic control tower for improved operations and safety.

Top 5 Growing Industries

INDUSTRY	NET JOB CREATION
1. Administrative, Support, Waste Management, and Remediation Services	585
2. Manufacturing	89
3. Information	66
4. Finance and Insurance	45
5. Agriculture, Forestry, Fishing, and Hunting	41

Source: Florida Department of Economic Opportunity, Labor Market Statistics Center. LEHD State of Florida County Reports-Quarterly Workforce Indicators 2010-2011

Largest Industry Sectors by Employment

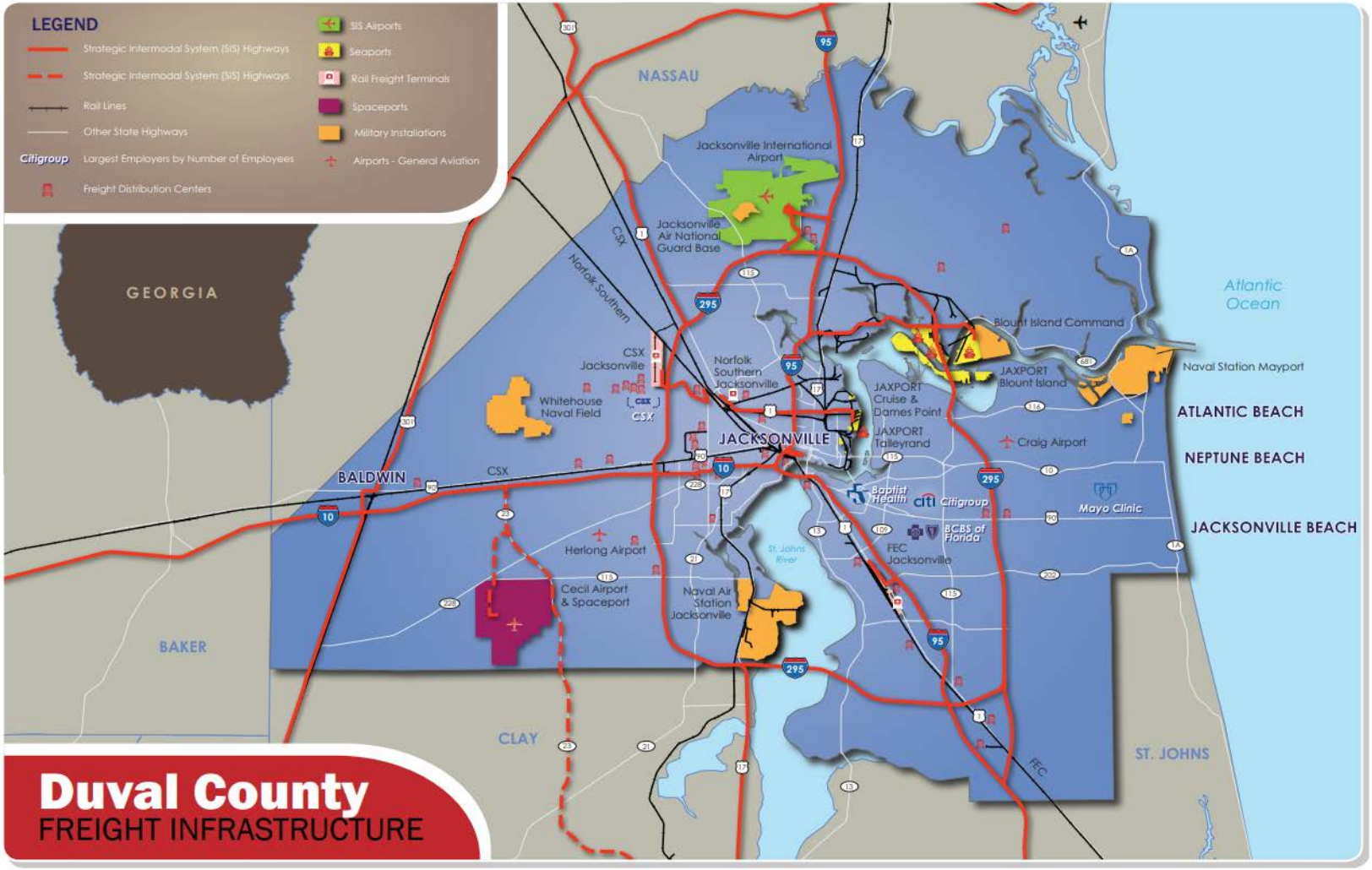
INDUSTRY SECTORS	% OF WORKFORCE
1. Trade, Transportation, and Utilities	24.5%
2. Education and Health Services	20.6%
3. Leisure and Hospitality	14.3%

Source: Enterprise Florida

Major Private Sector Employers

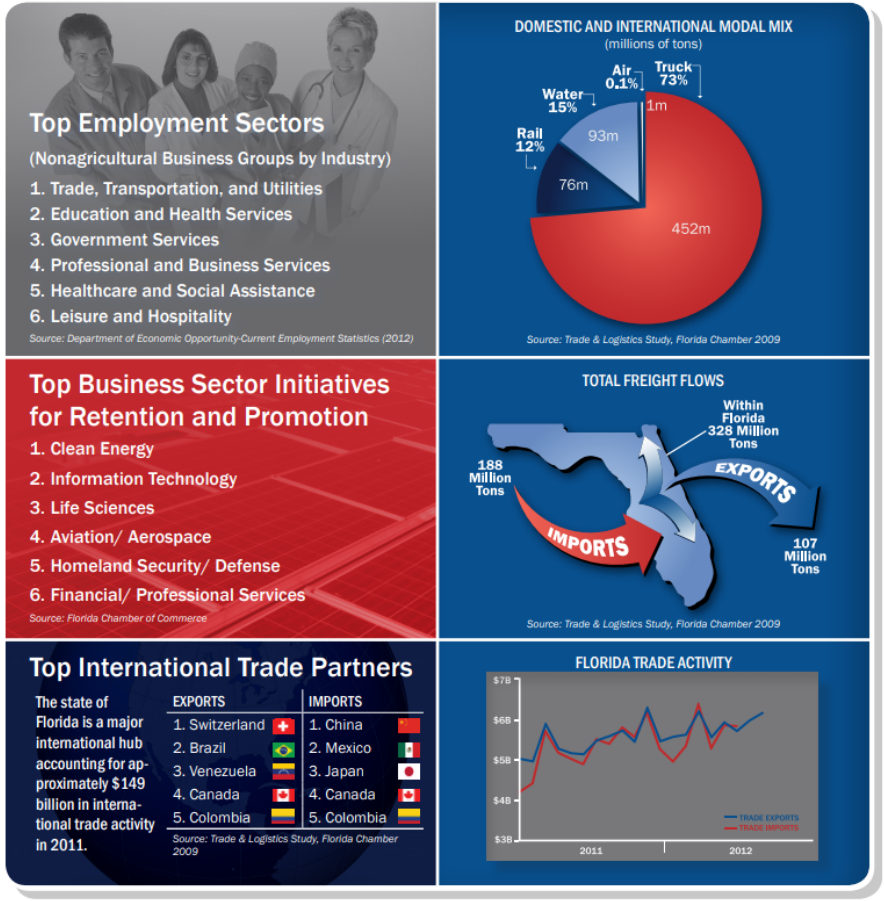
EMPLOYER	BUSINESS LINE	NUMBER OF EMPLOYEES
1. Wal-Mart Distribution Center	Distribution Center	1,044
2. Oak Hill Hospital	Healthcare	930
3. Spring Hill & Brooksville Regional Hospitals	Healthcare	900
4. Sparton Electronics	Manufacturer	325
5. Florida Crushed Stone	Mining	300

Source: Enterprise Florida


LEGEND
Strategic Intermodal System (SIS) Highways
Strategic Intermodal System (SIS) Highways
Rail Lines
Other State Highways
Citigroup Largest Employers by Number of Employees
Freight Distribution Centers
SIS Airports
Seaports
Rail Freight Terminals
Spaceports
Military Installations
Airports - General Aviation
NASSAU
GEORGIA
BAKER
CLAY
ST. JOHNS
BALDWIN
JACKSONVILLE
ATLANTIC BEACH
NEPTUNE BEACH
JACKSONVILLE BEACH
Atlantic Ocean
Jacksonville International Airport
Jacksonville Air National Guard Base
Norfolk Southern
CSX
CSX Jacksonville
Norfolk Southern Jacksonville
Whitehouse Naval Field
Herlong Airport
Cecil Airport & Spaceport
Naval Air Station Jacksonville
Blount Island Command
JAXPORT Blount Island
Naval Station Mayport
JAXPORT Cruise & Dames Point
JAXPORT Talleyrand
Craig Airport
Baptist Health
Citigroup
Mayo Clinic
BCBS of Florida
FEC Jacksonville
St. Johns River
FEC
Duval County
FREIGHT INFRASTRUCTURE

Successes & Challenges

- Shared with counties during development of Freight Mobility and Trade Plan to show local impacts of goods movement
- Great feedback from counties, cities, economic development agencies, local chambers
- Continued to be shared with local through FDOT District Freight Coordinators
- Once products started to become dated, considered update with different data and resources



Holly Cohen

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Florida Department of Transportation
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Questions?