NCFRP-50 Study Objective & Audience

➤ **Objective:** Develop guidance for stakeholders to mitigate and adapt to logistical disruptions to enhance freight transportation system resilience.

➤ **Target Audience:** Freight carriers and shippers, state transportation agencies, MPOs, freight advisory councils and other organizations interested in a resilient, sustainable and robust multimodal freight transportation system.

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NCFRP-50 Ten Corridor Scenarios

Modes, Disruptions and Commodities

#	Mode	Disruption	Commodity
1	Pipeline	Hurricane	Petroleum
2	Terminal	Cyber terrorism	Electronics
3	Port	Labor Issues	Agriculture
4	Highway	Earthquake	Computer Chips
5	Waterway	Low Water	Grains
6	Air/Truck	Theft	Pharaceuticals
7	Truck	Bridge Failure	Motorized Vehicles
8	Truck	Pandemic	Medical Instruments
9	Maritime	Carrier Issues	US Imports
10	Military	Terrorist event	Military Cargo

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Modeling Supply Chain Disruptions

➤ Rather than developing new models (which can be costly), the study team examined two *existing* models to best illustrate the impact of supply chain disruptions. They included:

➤ **Chicago Mesoscale Freight Model** developed for the Chicago Metropolitan Agency for Planning (CMAP)

➤ **Florida Statewide Model** using FreightSIM developed by RSG, Inc. for the Florida Department of Transportation (FDOT)

Freight Supply Chain Models

➤ Freight supply chain models assume the origin of the freight is the **shipper** of the freight and the **destination** is the receiver of that freight.

➤ This is different from trip-based models, which usually maintain a single mode for each trip made by freight but then need to treat the transfer between modes as the origin of a new trip, typically as a special freight generator.

➤ U.S. freight supply chain models that have been developed rely on the Freight Analysis Framework (FAF) dataset rather than actual data from individual shippers and receivers.
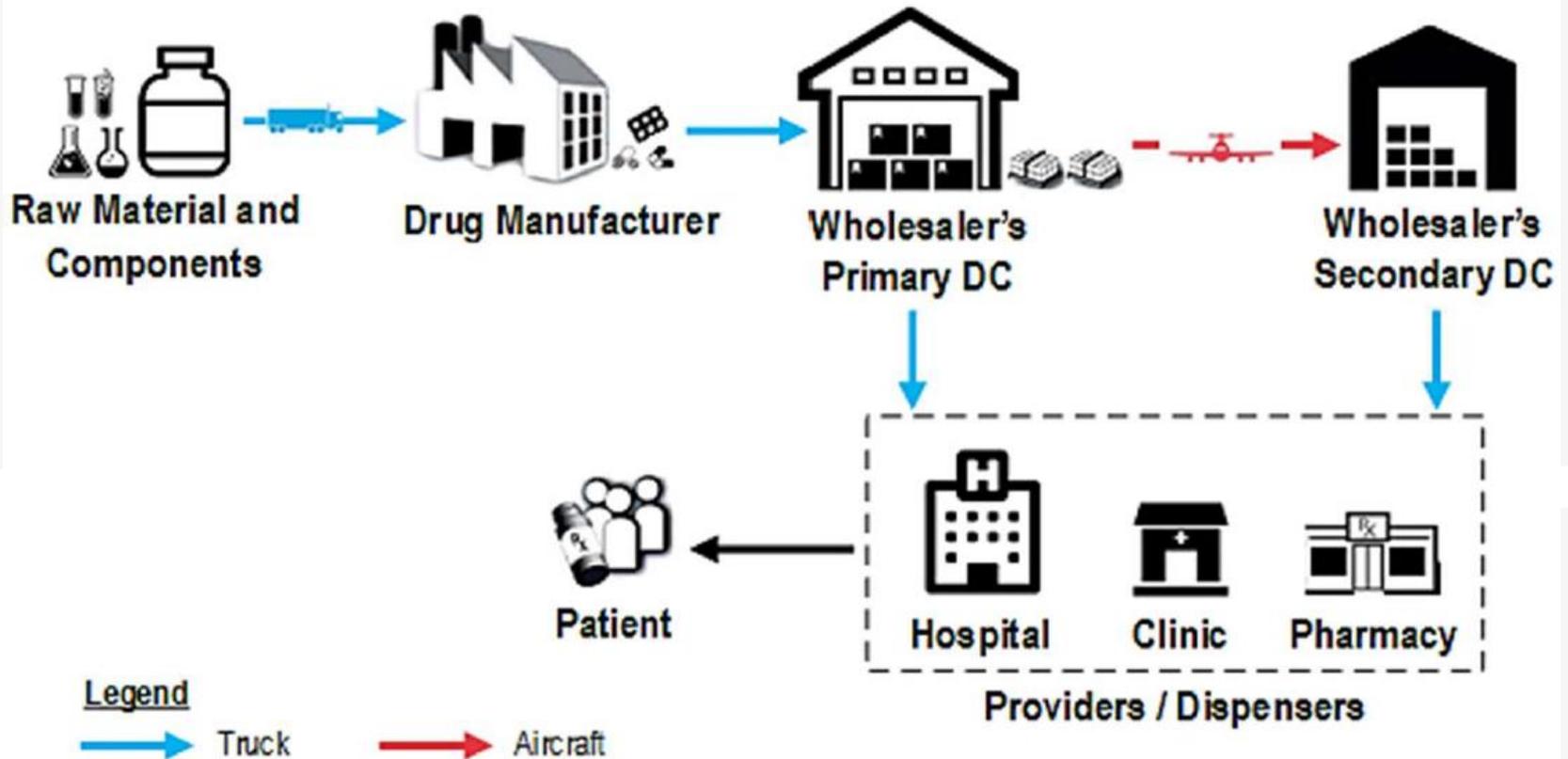
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Freight Supply Chain Models

➤ Currently supply chain models have been developed for several Metropolitan Planning Organizations: PSRC (Seattle); CMAP (Chicago); MAG (Phoenix); and several state DOTs: (Florida; Maryland; and Wisconsin).

➤ These models all use the FAF as the source of multi-supply chain flows. Therefore, if a supply chain has no reported tonnage in FAF, then the supply chain models will forecast no shift in tonnage as a result of supply chain disruptions.

➤ The total flows in FAF are used by the supply chain models, but FAF also reports on flows by mode which approximates supply chain families as used in the models. Several of the "modes" in FAF are either a combination of many supply chains, or where the supply chain was not specified.
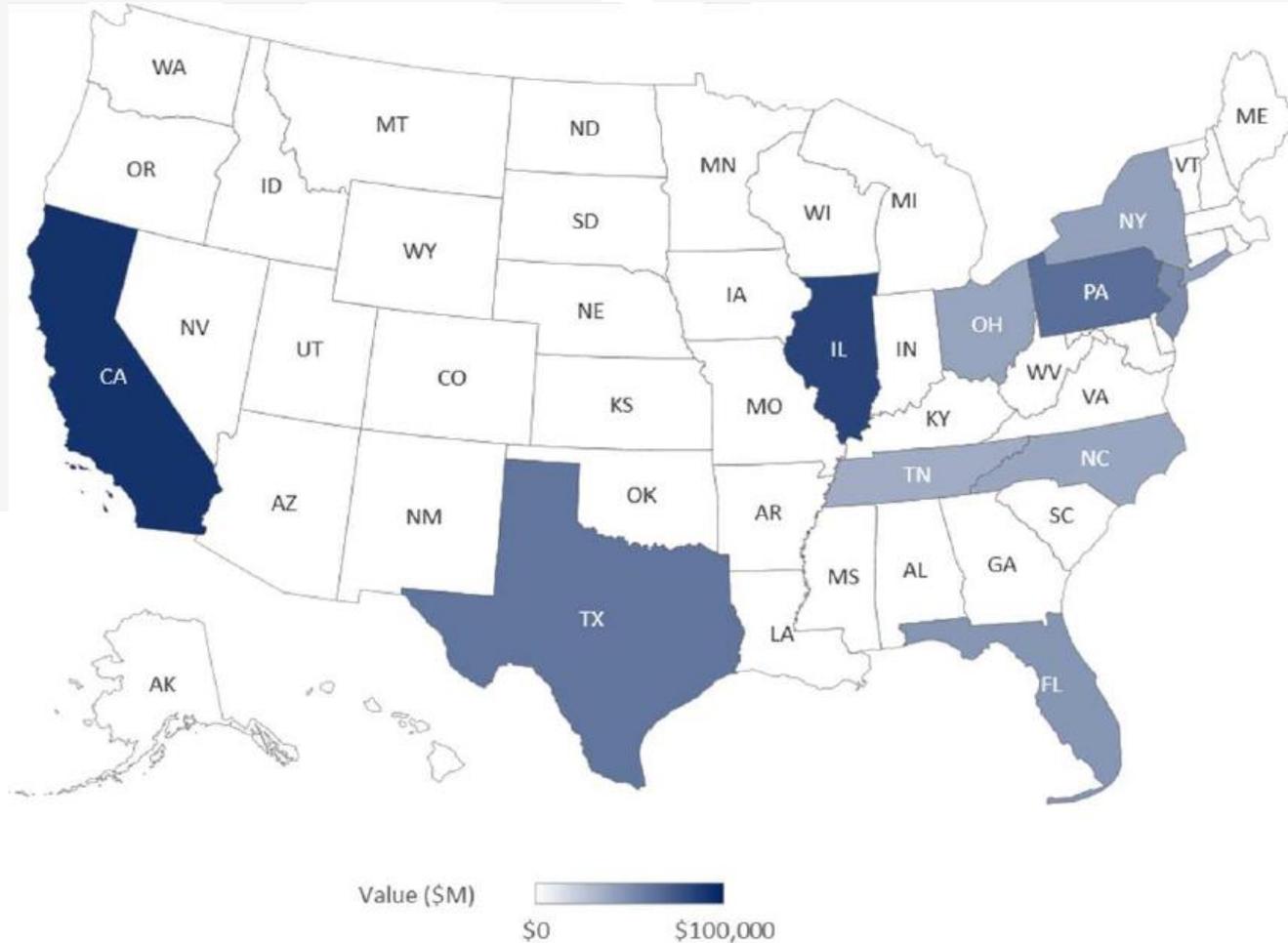
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Freight Supply Chain Models

➤ Supply chain models have been developed to address long-term planning impacts of changes in the transportation system and were not developed as short-term operational models.

➤ For example, FreightSIM only reports air, rail, truck, and water. FreightSIM does not report "multiple modes" as an output. For the disruption of the pharma air supply chain between Miami and Houston, we assume that "multiple modes and mail" (in FAF) is in fact "air."
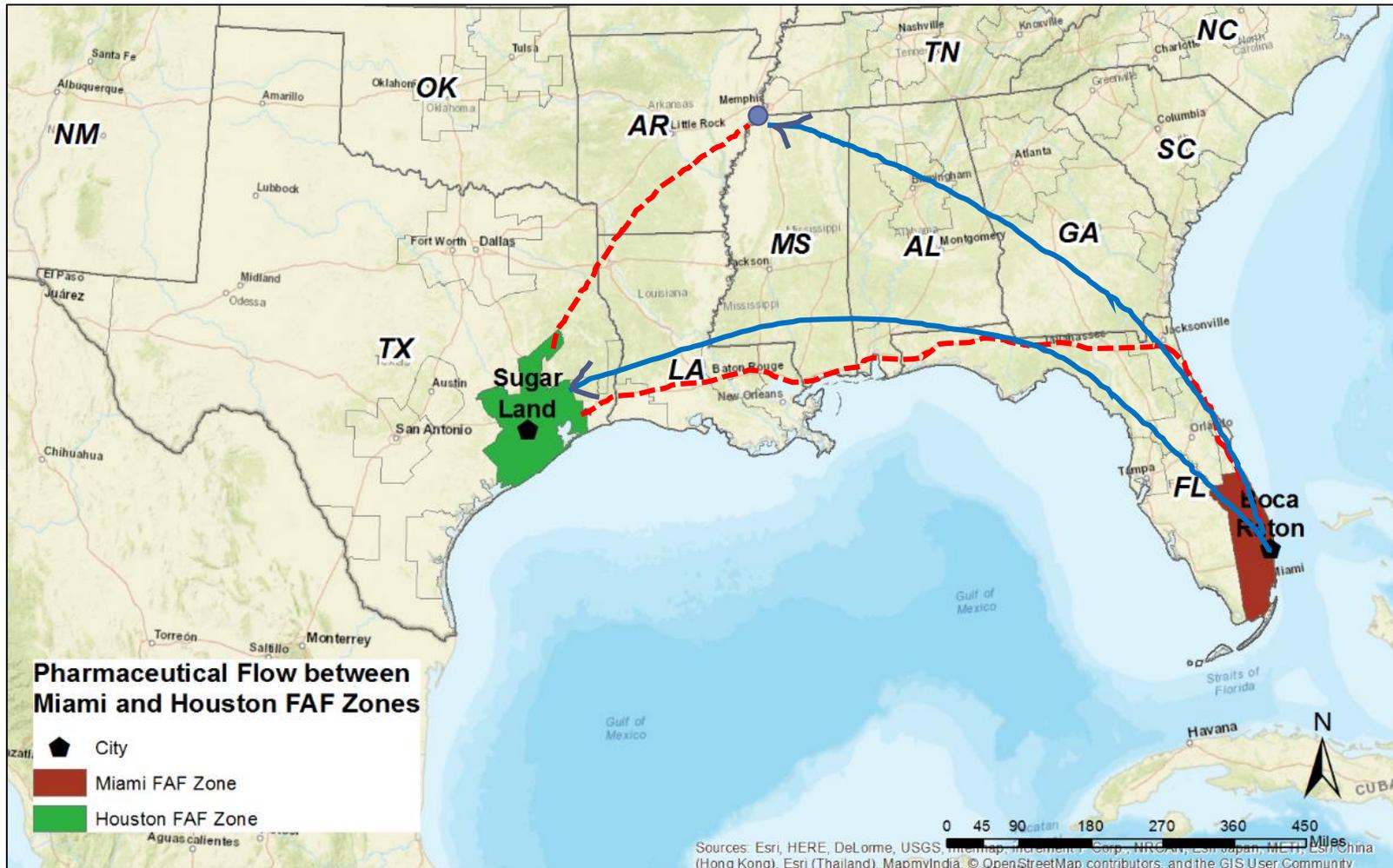
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Pharmaceutical Supply Chain

Source: WSP, adapted from U.S. Food and Drug Administration

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Top Ten U.S. Pharmaceutical Markets

Value ($M)

$0 $100,000

Source: FAF4

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Miami to Houston by Air and Truck

Pharmaceutical Flow between Miami and Houston FAF Zones

- ⬟ City
- ■ Miami FAF Zone
- ■ Houston FAF Zone

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Miami to Houston: Pharmaceuticals

➤ In the base case **Truck** was the dominant mode by both tonnage and value accounting for 60 percent of the total tonnage and value moved.

➤ **Air** was the second top transportation mode with 40 percent share of tonnage and value.

➤ In freight modelling, a mode path is selected based on the logistics cost. Therefore, low cost modes carry more volume compared to higher cost modes. FreightSIM uses a logistics costs function to predict the path, mode and movements of freight into, within, and out of Florida.

➤ By adjusting the constant value to increase total logistics costs, we effectively changed which mode path option was chosen by the model.

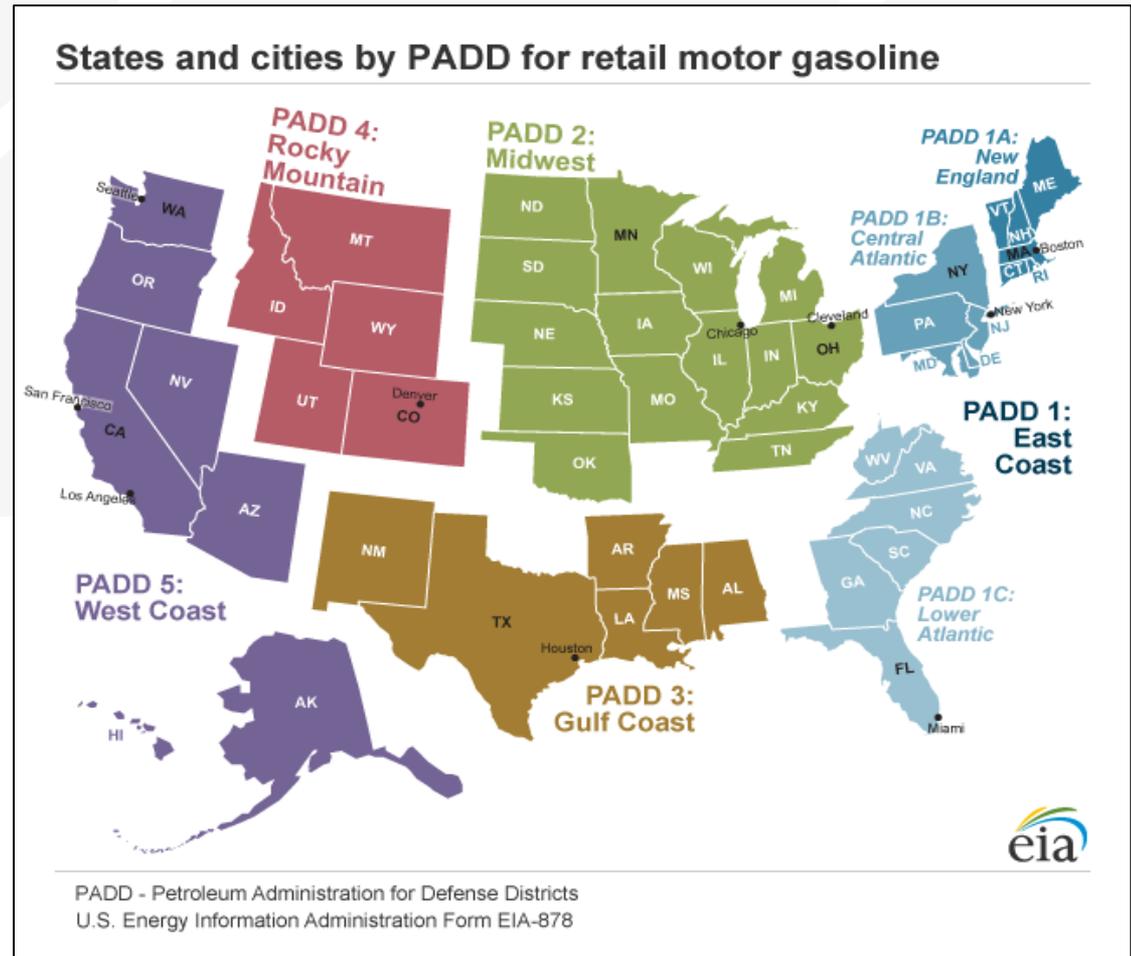CAMBRIDGE SYSTEMATICS

Pharmaceutical Supply Chain Disruptions

➤ Disruptions to the pharmaceutical supply chain include man-made events such as terrorism, cargo theft, fires and highway crashes and natural hazards such as floods, hurricanes or earthquakes.

➤ Last year, Texas was impacted by Hurricane *Harvey* and Florida was impacted by Hurricane *Irma* during the same month. In advance of each hurricane, a third party logistics (3PL) company transferred supplies to ensure minimal supply chain disruptions. (Note: this would be invisible to FAF, which only considers average annual flows without disruptions).

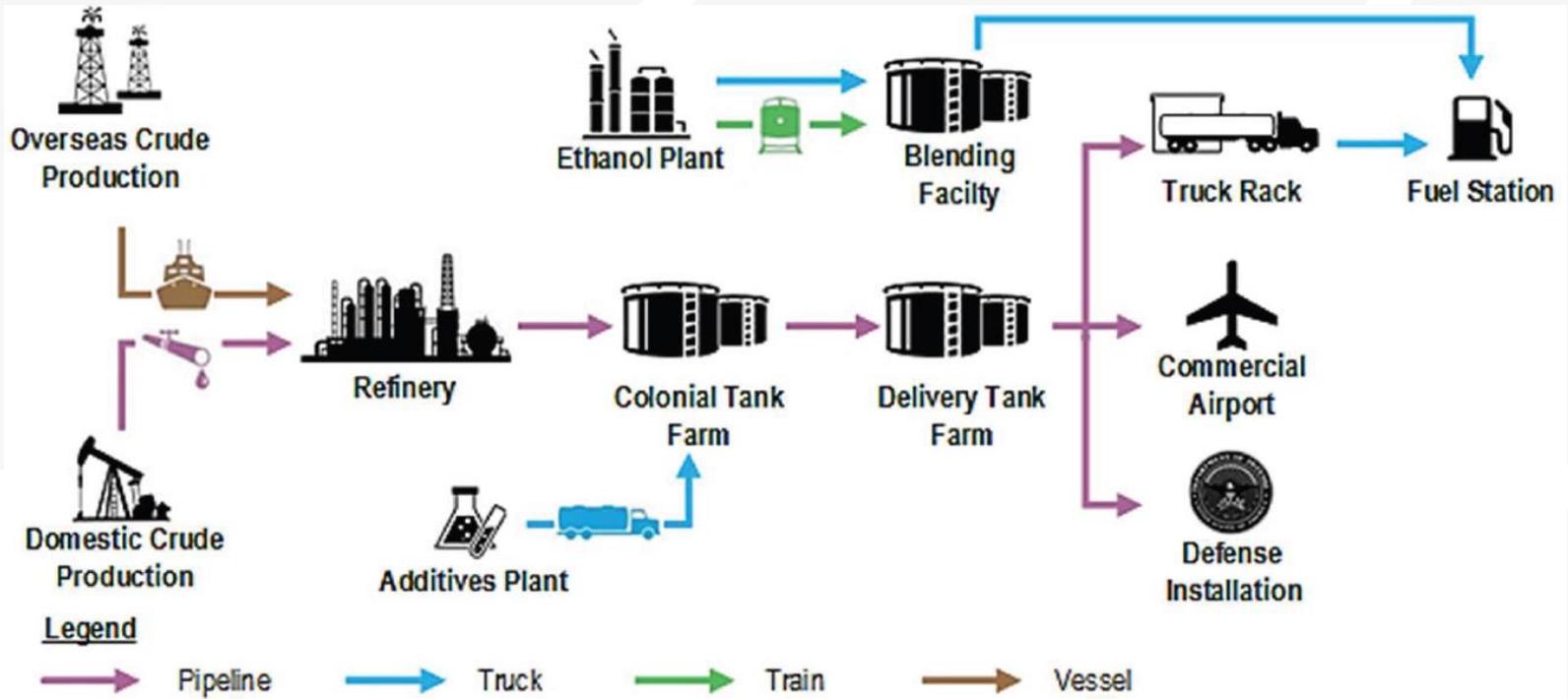CAMBRIDGE SYSTEMATICS

Modeling Disruptions without a Model

➤ Since MWCOG does not have a freight model, one idea is to examine the FAF to see which flows appear vulnerable to disruption.

➤ In the two modelling examples in NCFRP 50 presented today, the tonnage flows shifted to the second most used supply chain as reported in the FAF. This could have been anticipated without the use of the model.

➤ Supply chain models, as long term models, can only shift between available supply chains.

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U.S. Refined Petroleum Distribution

- Petroleum Administration for Defense Districts (PADD)

- Allows for analysis of patterns of transportation fuel movements throughout the country

- More than 50% of inter-PADD petroleum product pipeline movements in the US – from Gulf Coast (PADD 3) to East Coast (PADD 1)

States and cities by PADD for retail motor gasoline

PADD 4: Rocky Mountain
PADD 2: Midwest
PADD 1A: New England
PADD 1B: Central Atlantic
PADD 1: East Coast
PADD 5: West Coast
PADD 3: Gulf Coast
PADD 1C: Lower Atlantic

PADD - Petroleum Administration for Defense Districts
U.S. Energy Information Administration Form EIA-878

eia

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Petroleum Supply Chain

Source: WSP
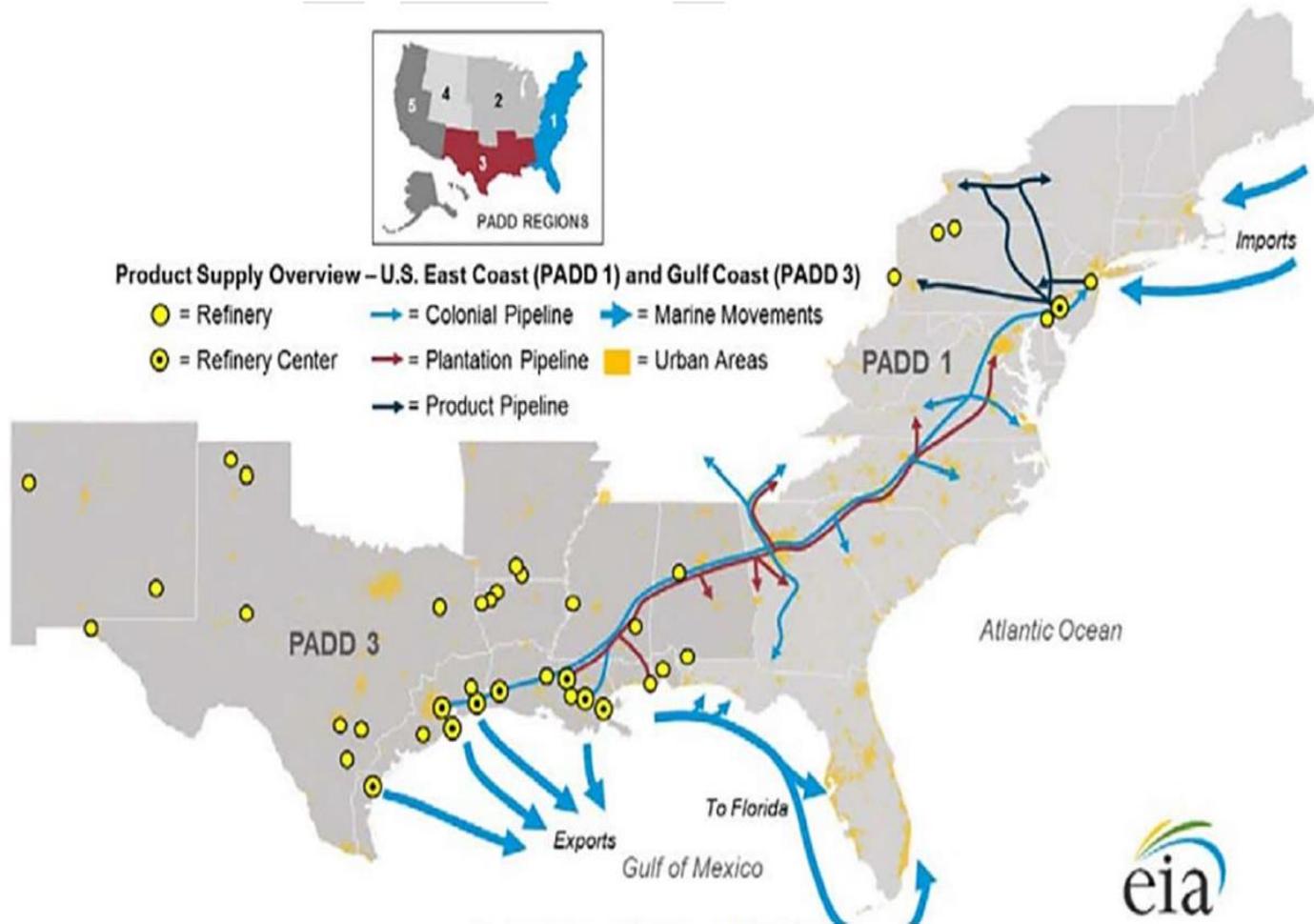
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Mid-Atlantic Petroleum Supply Chain

- The **Colonial Pipeline** delivers 2,200,000 bb/d from Texas to New Jersey.

- The **Plantation Pipeline** delivers 700,000 bb/d from Louisiana to Virginia and Washington, D.C.

- Petroleum is a vital commodity in disaster recovery efforts, and particularly critical for military, emergency and other transport vehicles, as well as for residential heating and emergency generators during disruptions.

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Petroleum Disruption Examples

➤ In September 2016, **Colonial Pipeline** shut down Line 1 in response to a leak estimated to have released 250,000 to 330,000 gallons of gasoline in Shelby County, Alabama

➤ **Hurricane *Katrina*** knocked out power to seven pump stations in Mississippi and Louisiana. Two mainlines were shut down for approximately 55 hours.

➤ **Hurricane *Rita*** knocked out power to five pump stations in Texas and Louisiana. Two mainlines were shut down for 48 hours.

Alternative Supply Chain Corridors

Product Supply Overview – U.S. East Coast (PADD 1) and Gulf Coast (PADD 3)

Source: EIA

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Petroleum Diversion Alternatives

➤ For petroleum products travelling from the Gulf Coast to the East Coast, there are two alternatives to the Colonial system: the Plantation Pipeline, or maritime movement by tanker and barge. As previously noted, the Plantation Pipeline is a separate pipeline that has a capacity of 700,000 barrels per day.

➤ Waterborne transport of fuels from the Gulf Coast to the East Coast can deliver approximately 500,000 barrels per day. Both alternatives have a significantly lower capacity than the Colonial Pipeline.

➤ Rail transport of oil and petroleum mainly takes place between the Midwest and East Coast.

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Questions

Michael D. Meyer, Project Manager
WSP/Parsons Brinckerhoff
NCFRP-50
mm39prof@gmail.com
678-984-8521

David O. Willauer, Freight Manager
Cambridge Systematics
NCFRP-50
dwillauer@camsys.com
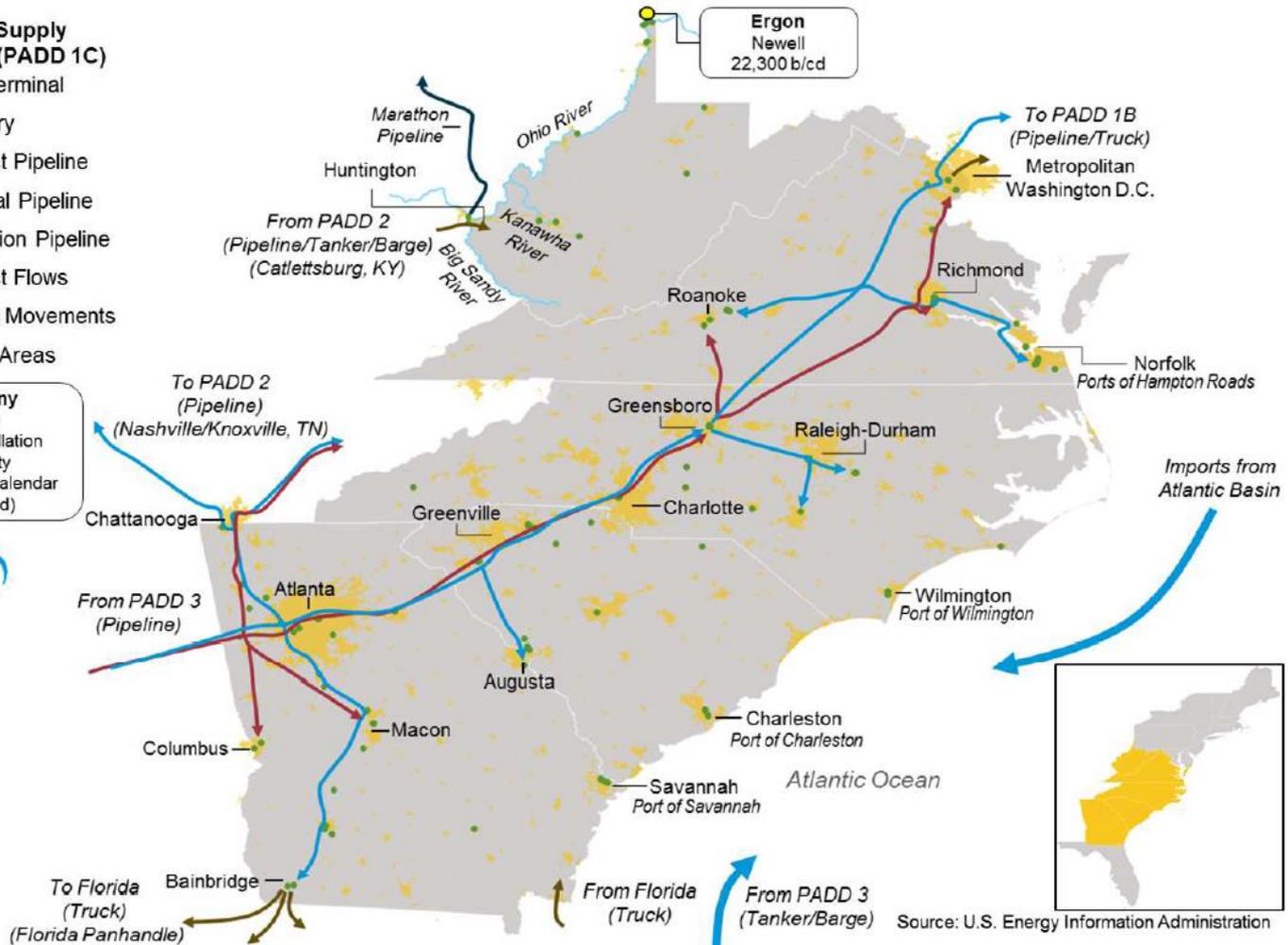240-515-5223

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Southeast Petroleum Assets

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Mid-Atlantic Petroleum Assets

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