The Freight Analysis Framework (FAF): Leveraging Federal Statistical Programs to Understand US Goods Movement

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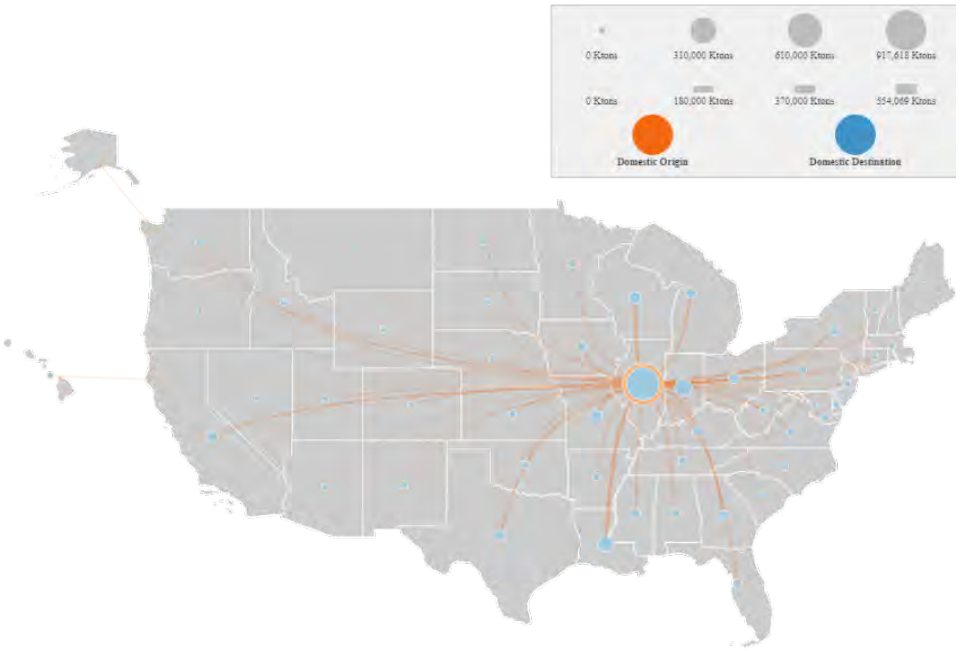
Presentation Topics

- FAF
  - Product overview
  - Applications
  - Development, including CFS and other inputs
- Limitations of FAF
- Future directions
  - Impact of expanded CFS sample
  - Other possibilities

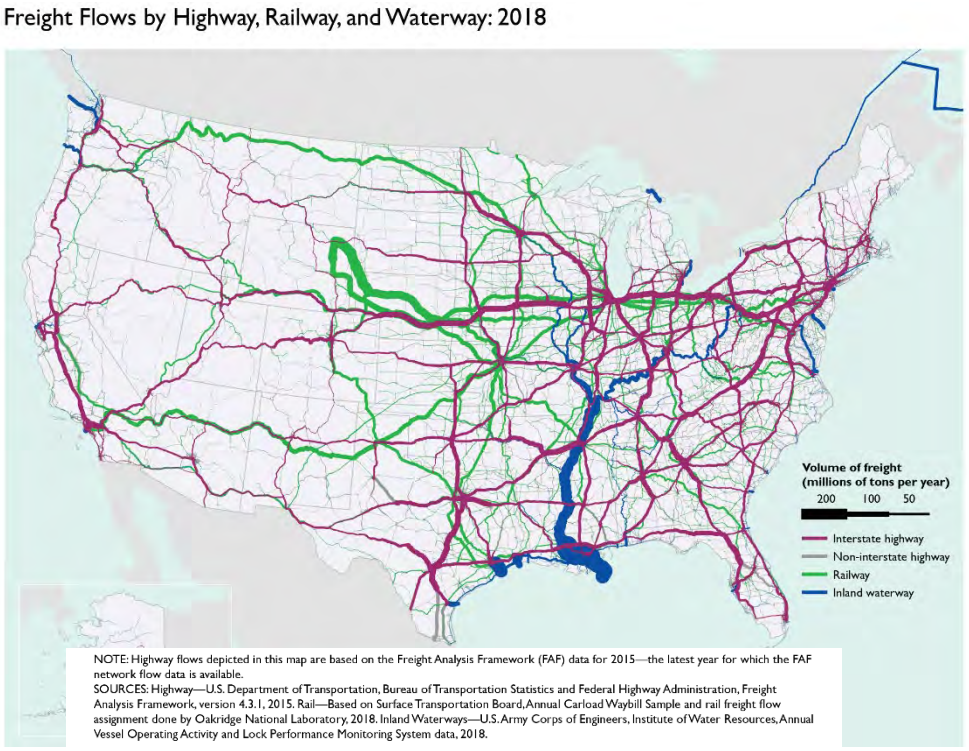
FAF Provides Estimates of US Freight Flows

<u>Product 1:</u> Database of flows by Origin (O), Destination (D), Commodity, & Mode

- Includes foreign O/D and mode (if applicable)
- Volumes: tons, value, and ton-miles



<u>Product 2:</u> Network flows by Truck, Rail and Water (e.g., estimated volumes on interstates)

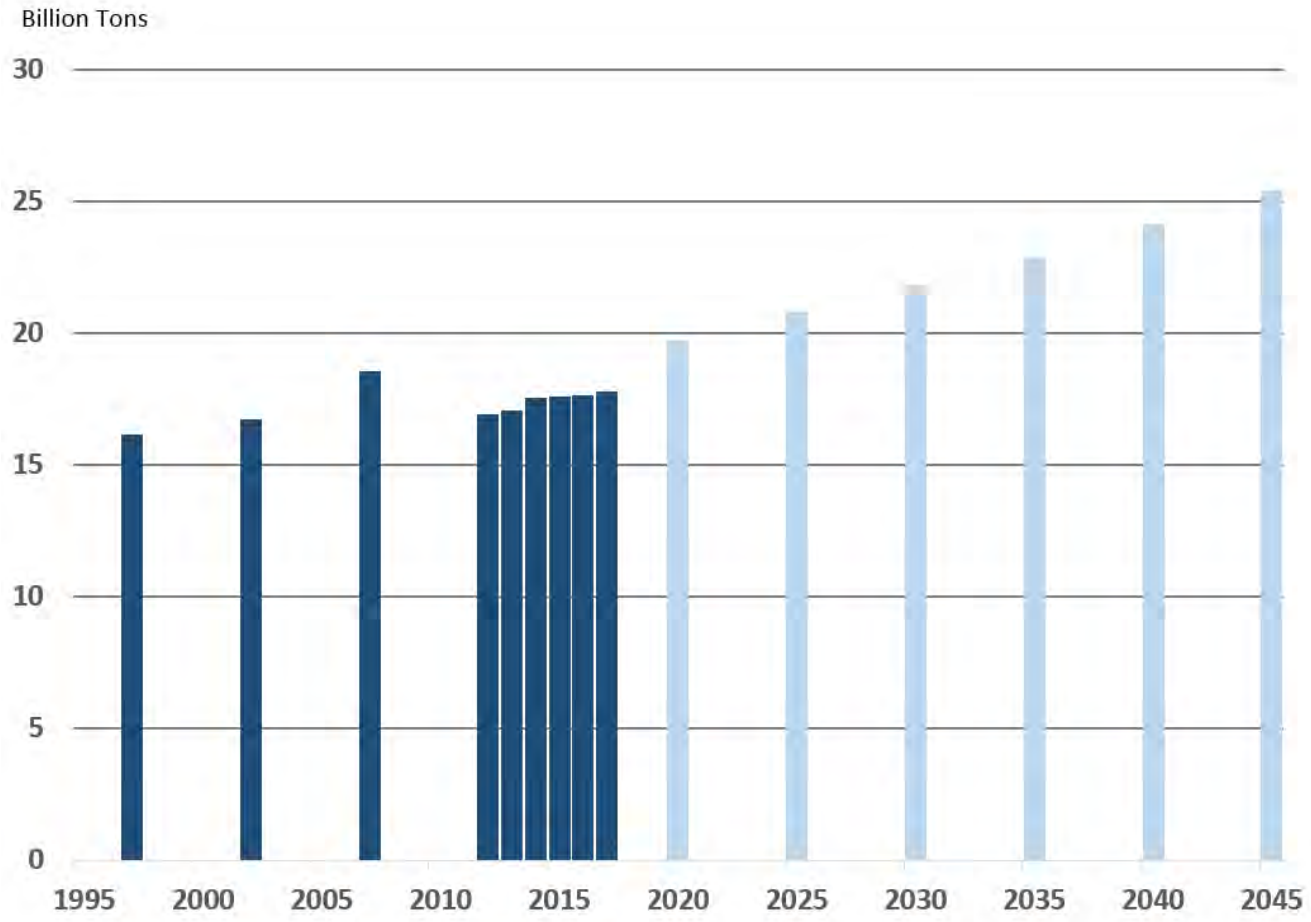


*FAF5 is developed by the Bureau of Transportation Statistics (BTS) in partnership with Federal Highway Administration (FHWA)

Beyond the Present Day

- Annual Estimates
- Historic Series
- Forecasts

Illustration for FAF4



Access FAF at: **https://www.bts.gov/faf**

- Use the FAF5 Data Tabulation Tool

- **Regional** database of tonnage and value by origin-destination pair, commodity type, and mode.
  - FAF5.4 **Regional Database** for 2017 and forecasts up to 2050 (**mid-range estimates only**): FAF5.4_access.zip (MS Access) | FAF5.4.zip (.csv)
  - FAF5.4 **Regional Database** for 2017 and forecasts up to 2050 (**including high and low estimates**): FAF5.4_HiLoForecasts_access.zip (MS Access) | FAF5.4_HiLoForecasts.zip (.csv)
  - FAF5.4 **Regional Database** for 2018-2020: FAF5.4_2018-2020_access.zip (MS Access) | FAF5.4_2018-2020.zip (.csv)
- **State** database of tonnage and value by origin-destination pair, commodity type, and mode.
  - FAF5.4 **State** Database for 2017 and forecasts up to 2050 (**mid-range estimates only**): FAF5.4_State_access.zip (MS Access) | FAF5.4_State.zip (.csv)
  - FAF5.4 **State** Database for 2017 and forecasts up to 2050 (**including high and low estimates**): FAF5.4_State_HiLoForecasts_access.zip (MS Access) | FAF5.4_State_HiLoForecasts_.zip (.csv)
  - FAF5.4 **State** Database for 2018-2020: FAF5.4_State_2018-2020_access.zip (MS Access) | FAF5.4_State_2018-2020.zip (.csv)
  - FAF5.4 **Reprocessed State Level Annual Data for 1997-2012**: FAF5.4_Reprocessed_1997-2012_State_access.zip (MS Access) | FAF5.4_Reprocessed_1997-2012_State.zip (.csv)

FAF5 Network Data

- FAF5 Truck Network Database and Flow Assignment for 2017, 2022, and 2050

Summary Statistics and Products

- Summary Tables by Mode and Commodity

Documentation

- FAF5 User Guide

Web-based data tabulation tool (DTT)

OD Flows (current & future years):

Region-to-region (132 regions)

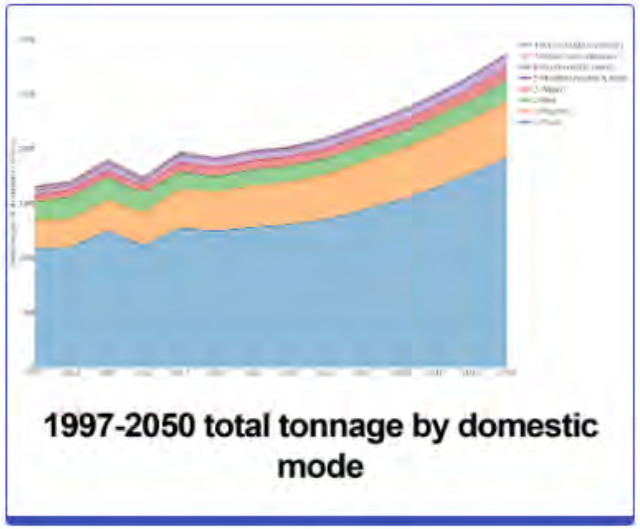
&

State-to-state (also has historical to 1997)

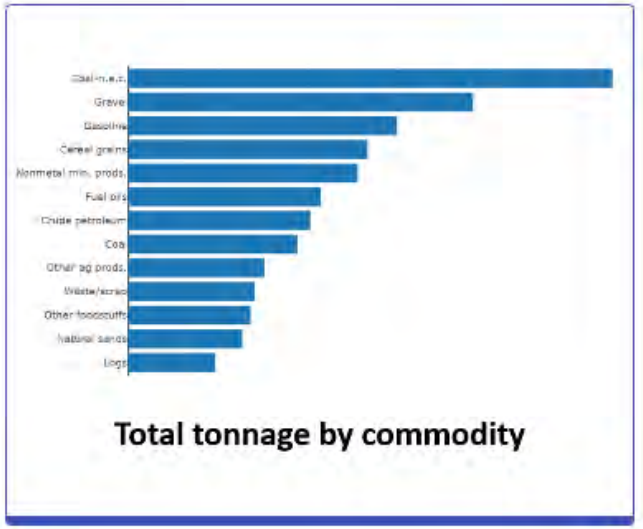
Network Flows (truck)

Other (summary statistics, documentation, …)

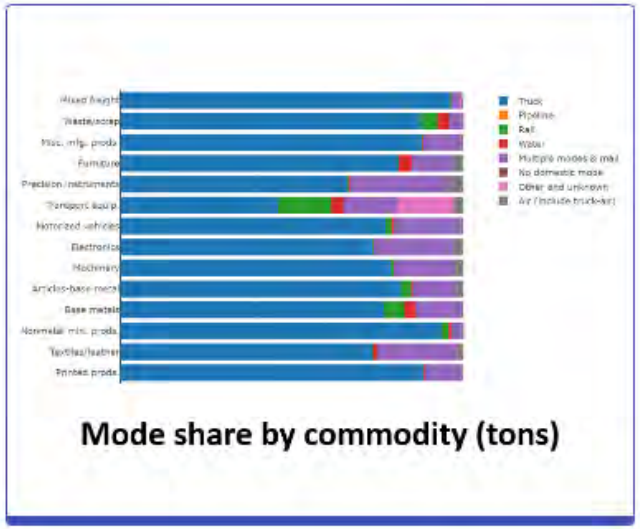
Data Tabulation Tool (DTT): Create visual or tabular summaries of OD flows by mode, commodity, region, and more



1997-2050 total tonnage by domestic mode

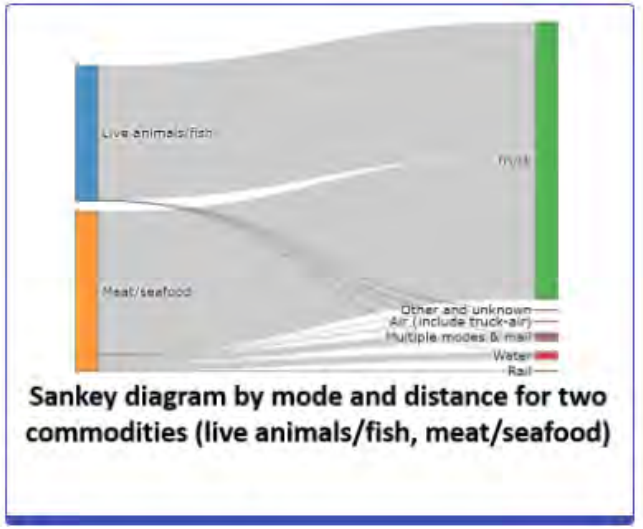


Total tonnage by commodity

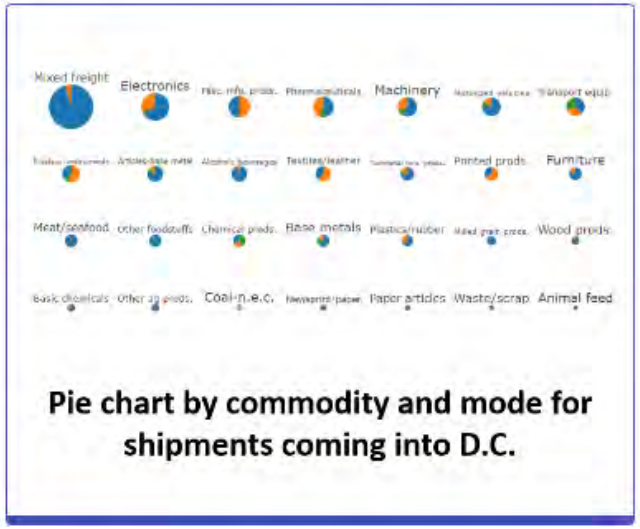


Mode share by commodity (tons)

State Level Origin-Destination Flows (tons)



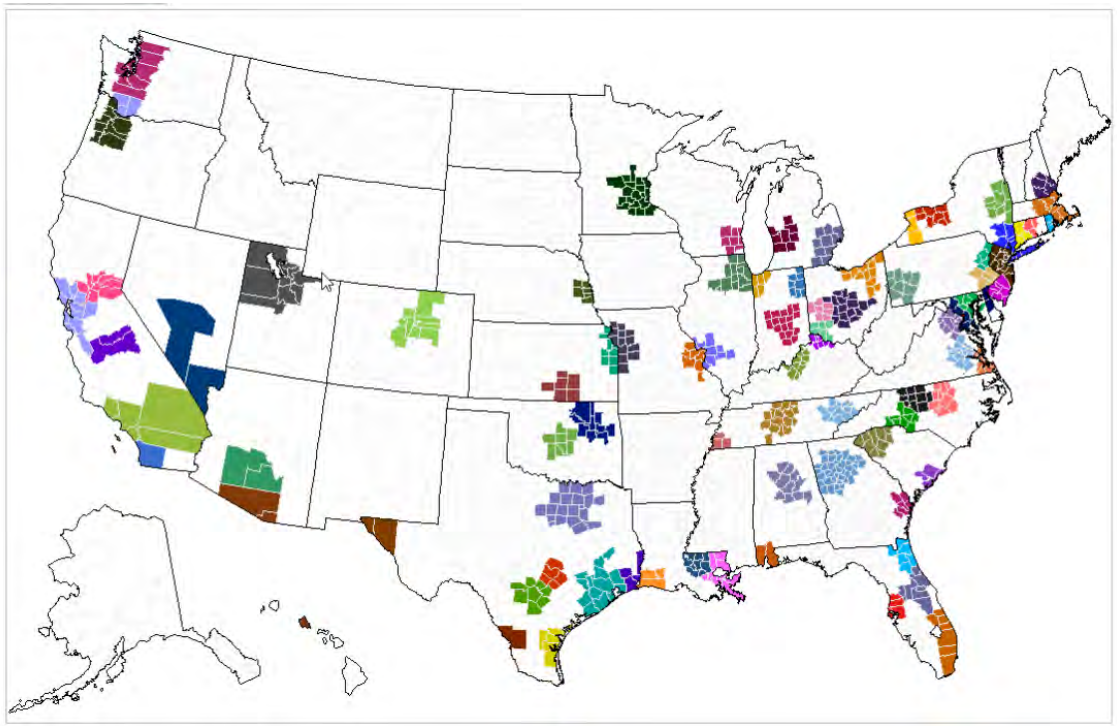
Sankey diagram by mode and distance for two commodities (live animals/fish, meat/seafood)



Pie chart by commodity and mode for shipments coming into D.C.

Level of Detail: Geographic

132 domestic regions



https://www2.census.gov/programs-surveys/cfs/technical-documentation/methodology/2017cfsarea.pdf 2017cfsarea.pdf (census.gov)

8 foreign regions

FAF ZONE	Foreign Region
801	Canada
802	Mexico
803	Rest of Americas
804	Europe
805	Africa
806	Southern, Central, and Western Asia
807	Eastern Asia
808	Southeastern Asia and Oceania

https://www.bts.gov/archive/subject_areas/freight_transportation/faf/faf4/app_d

Level of Detail: Commodity

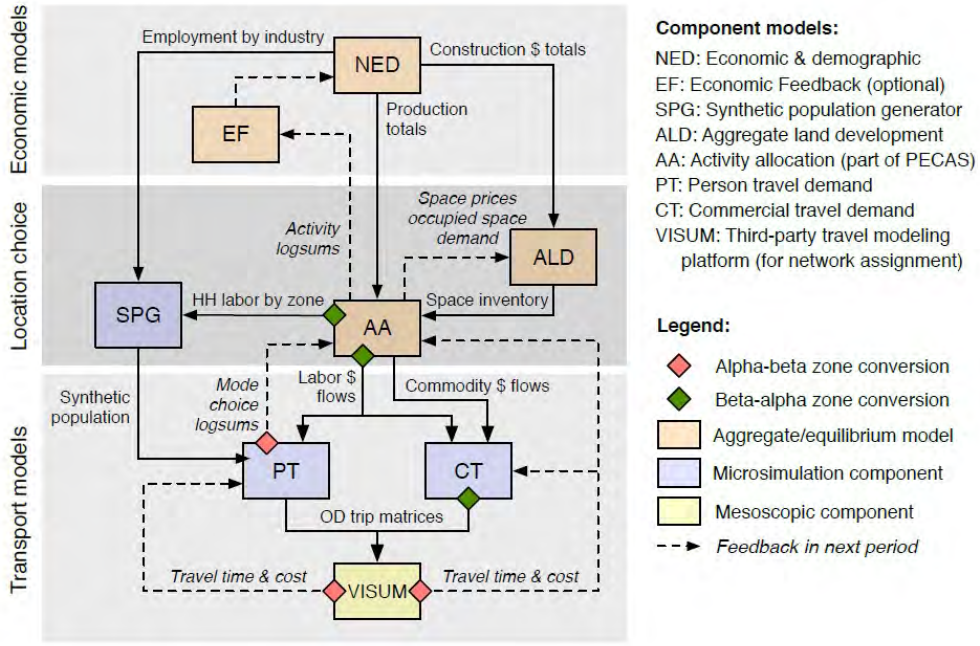
SCTG2: 2-digit Standard Classification of Transported Goods (numbered 1 to 43)

Code	Commodity Description
01	Animals and Fish (live)
02	Cereal Grains (includes seed)
03	Agricultural Products (excludes Animal Feed, Cereal Grains, and Forage Products)
04	Animal Feed, Eggs, Honey, and Other Products of Animal Origin
05	Meat, Poultry, Fish, Seafood, and Their Preparations
06	Milled Grain Products and Preparations, and Bakery Products
07	Other Prepared Foodstuffs, Fats and Oils
08	Alcoholic Beverages and Denatured Alcohol
09	Tobacco Products
10	Monumental or Building Stone
11	Natural Sands
12	Gravel and Crushed Stone (excludes Dolomite and Slate)
13	Other Non-Metallic Minerals not elsewhere classified
14	Metallic Ores and Concentrates
15	Coal
16	Crude Petroleum
17	Gasoline, Aviation Turbine Fuel, and Ethanol (includes Kerosene, and Fuel Alcohols)
18	Fuel Oils (includes Diesel, Bunker C, and Biodiesel)
19	Other Coal and Petroleum Products, not elsewhere classified
20	Basic Chemicals
21	Pharmaceutical Products
22	Fertilizers
23	Other Chemical Products and Preparations
24	Plastics and Rubber
25	Logs and Other Wood in the Rough
26	Wood Products
27	Pulp, Newsprint, Paper, and Paperboard
28	Paper or Paperboard Articles
29	Printed Products
30	Textiles, Leather, and Articles of Textiles or Leather
31	Non-Metallic Mineral Products
32	Base Metal in Primary or Semi-Finished Forms and in Finished Basic Shapes
33	Articles of Base Metal
34	Machinery
35	Electronic and Other Electrical Equipment and Components, and Office Equipment
36	Motorized and Other Vehicles (includes parts)
37	Transportation Equipment, not elsewhere classified
38	Precision Instruments and Apparatus
39	Furniture, Mattresses and Mattress Supports, Lamps, Lighting Fittings, and Illuminated Signs
40	Miscellaneous Manufactured Products
41	Waste and Scrap (excludes of agriculture or food)
43	Mixed Freight

Applications: Local, Regional, and Statewide Freight Transportation Analysis

- Sectors
  - Public: transportation planning agencies
  - Private
    - Real estate development
    - Transportation & warehousing companies, e.g., third-party logistics providers (3PLs)
  - Academic researchers
- Transportation planning applications
  - Assess current system performance
  - Plan for the future, esp. identifying funding needs
  - Highway: bottleneck analysis → understand what goods are impacted
  - Asset management (infrastructure) – e.g., pavement, bridges
- Supply chain analysis
  - Top domestic and foreign trading partners
  - Top commodities
  - Mode shares
- Climate resilience
- Et cetera…

- Examples:
  - Connecticut Statewide Freight Plan https://portal.ct.gov/-/media/DOT/FASTLANE/Freight_Plan/CTDOTFreightPlanFinal111617pdf.pdf?la=en
  - District (DC) Freight Plan – update: https://ddot.dc.gov/sites/default/files/dc/sites/ddot/TAMP_Master_SlideDeck_v3.pdf
  - Oregon Statewide Model:



Example Application

Bureau of Transportation Statistics

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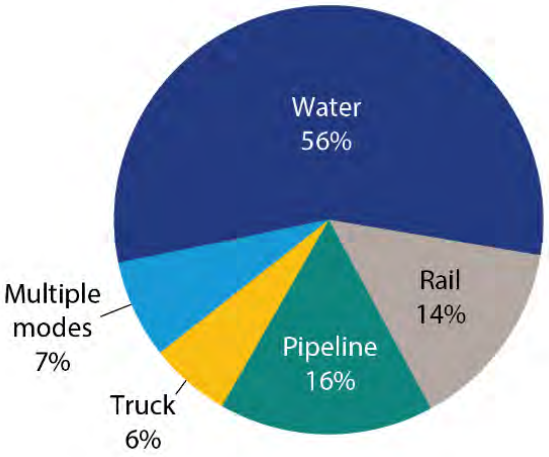
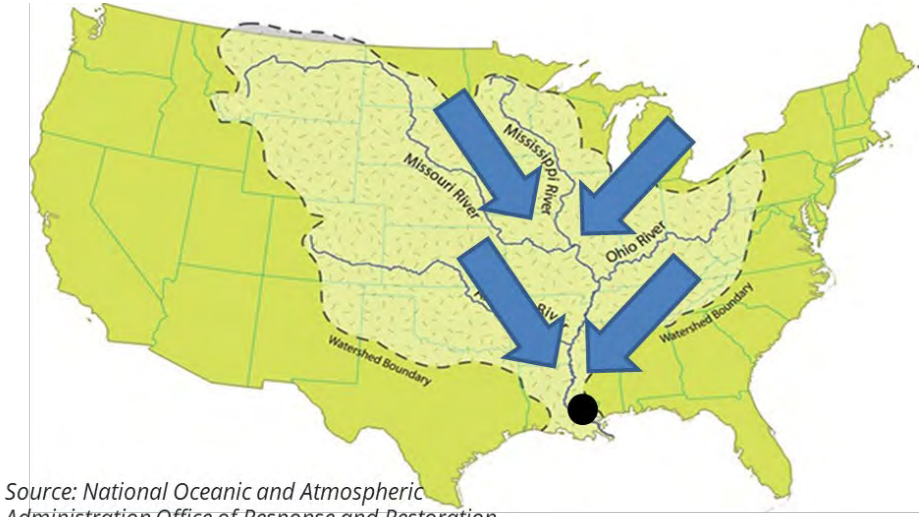
Home / Data Spotlights

Catalog of COVID-19 Related Transportation Statistics

Low Water on the Mississippi Slows Critical Freight Flows

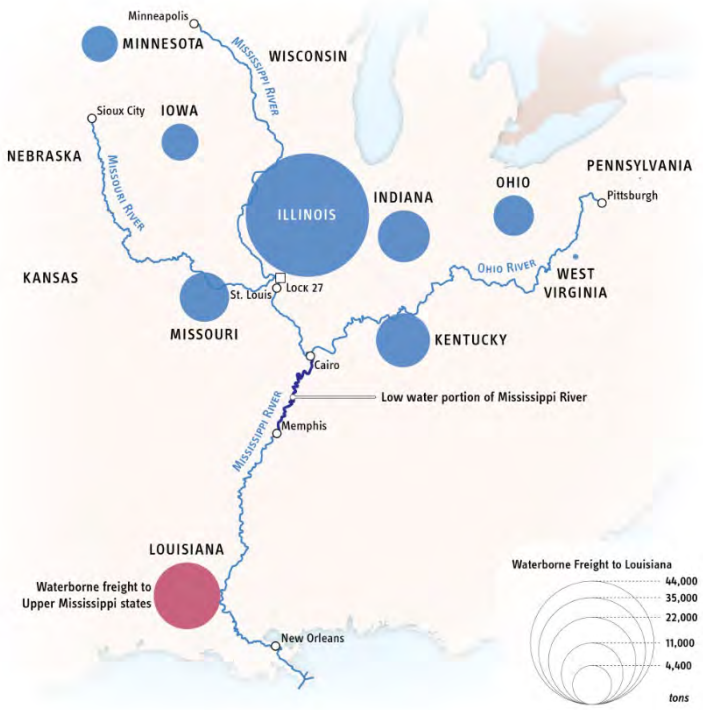
Wednesday, November 16, 2022



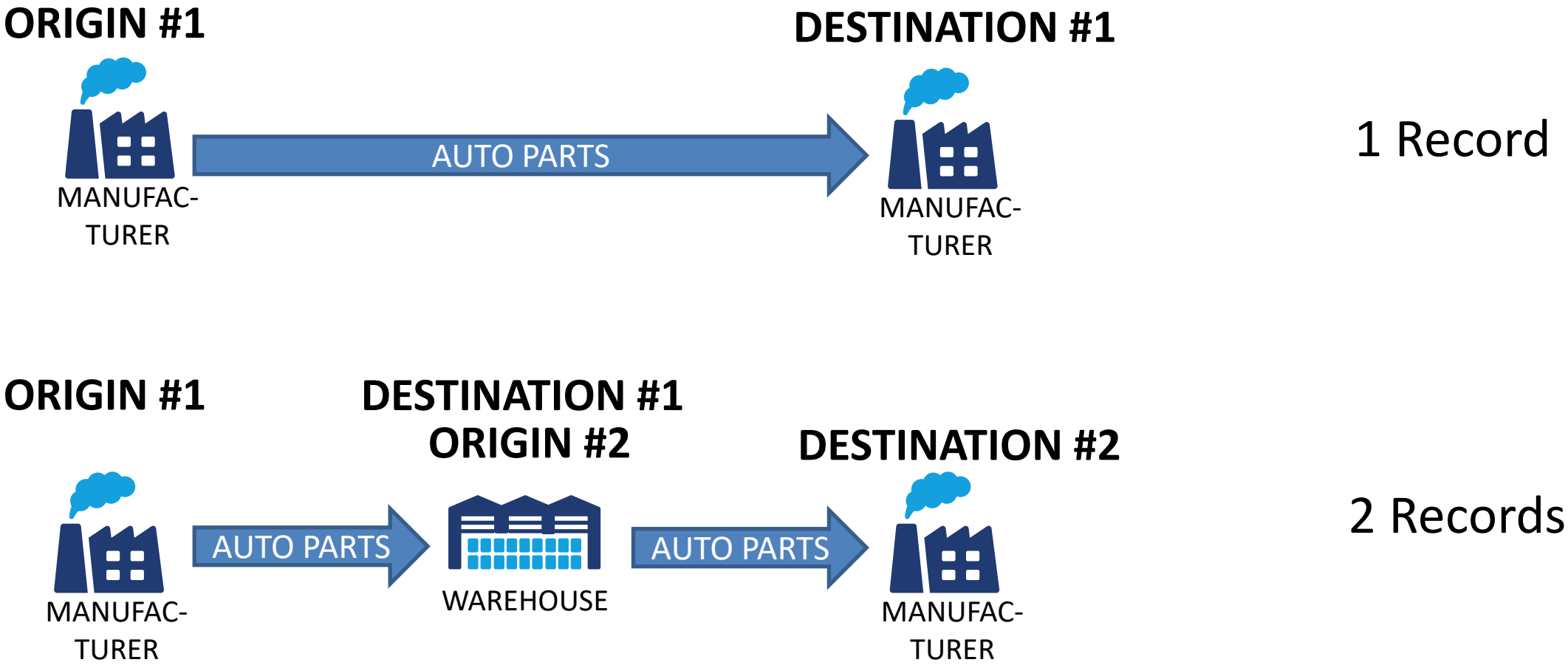


Source: National Oceanic and Atmospheric Administration Office of Response and Restoration

Economic impacts by state:



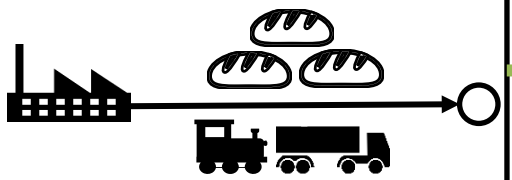
Purpose of FAF: Transportation Analysis → Data and Processes Focus on Capturing Freight Trips



Development: Commodity Flow Estimates

Main Input: the BTS-Census Commodity Flow Survey (CFS)

CFS SHIPMENT DATA



IPF

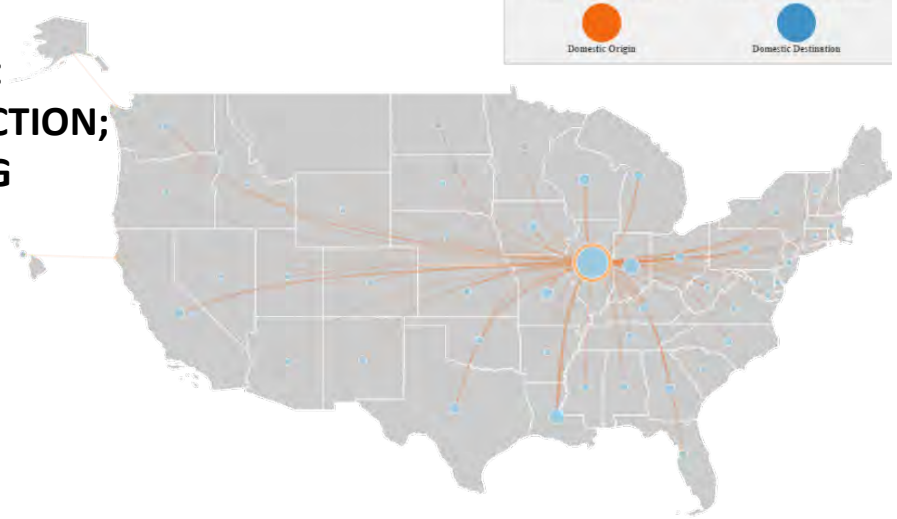
FLOWS or PRODUCTION VOLUME DATA:

11 OOS (Out of Scope) Data Sources:
Farm-based agriculture, fisheries, logging, crude petroleum, natural gas, retail, service, moving, foreign trade, construction and demolition, waste [from USDA, NOAA, EPA, Census FTD / USATO, BEA, EIA, USACE, states, industries]

Various Processes

PRODUCT #1:
OD FLOWS DATABASE

METHODS:
CONSTRUCTION; MODELING



Origin	Destin-ation	SCTG2	Tons	Value	Ton-miles	Dom-estic Mode	Foreign Mode
Wyo-ming	Chicago region	Coal	xx	xx	xx	xx	xx
…	…	…	…	…	…		

IPF: Iterative Proportional Fitting

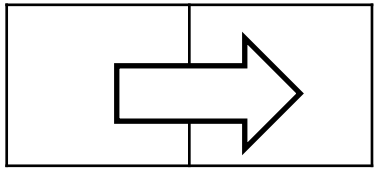
Development: Network Flow Estimates

Main Input: OD flow estimates

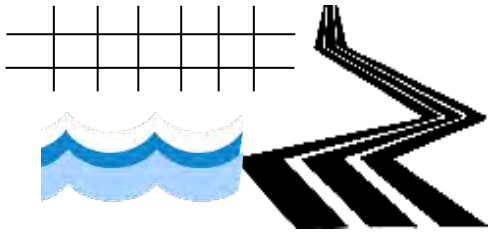
PRODUCT #1:

OD FLOWS DATABASE

FAF REGIONS

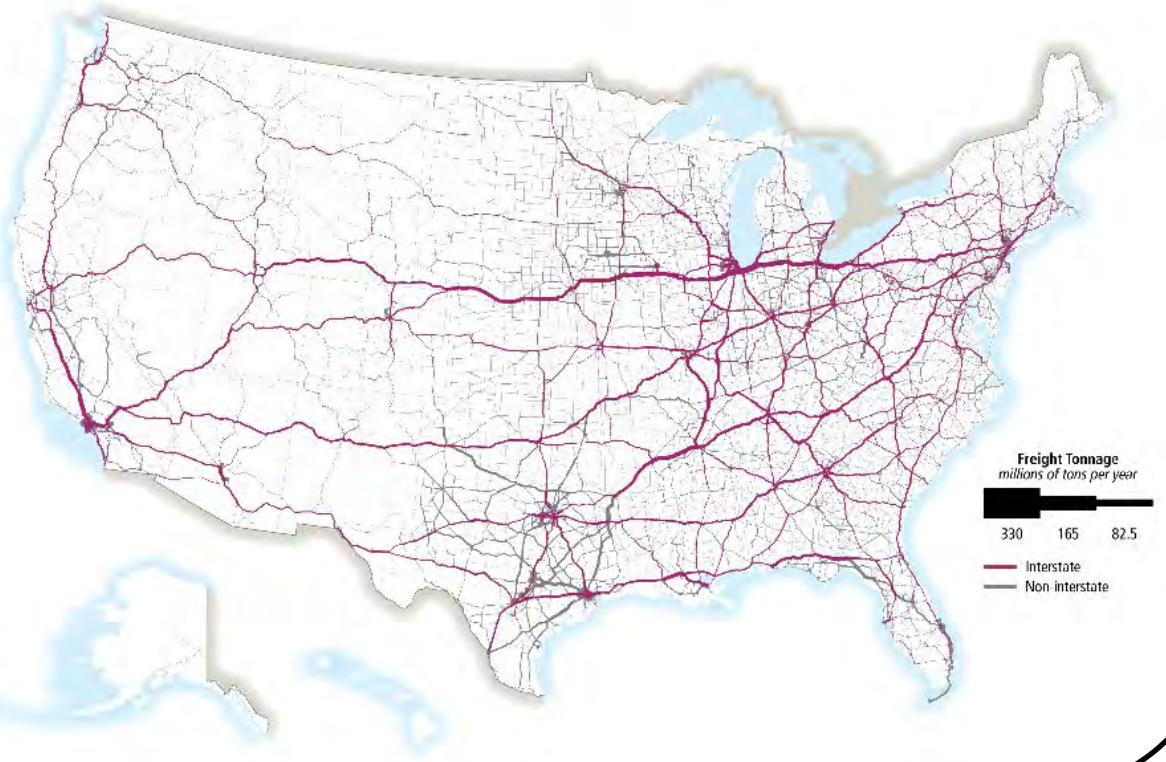


NETWORKS

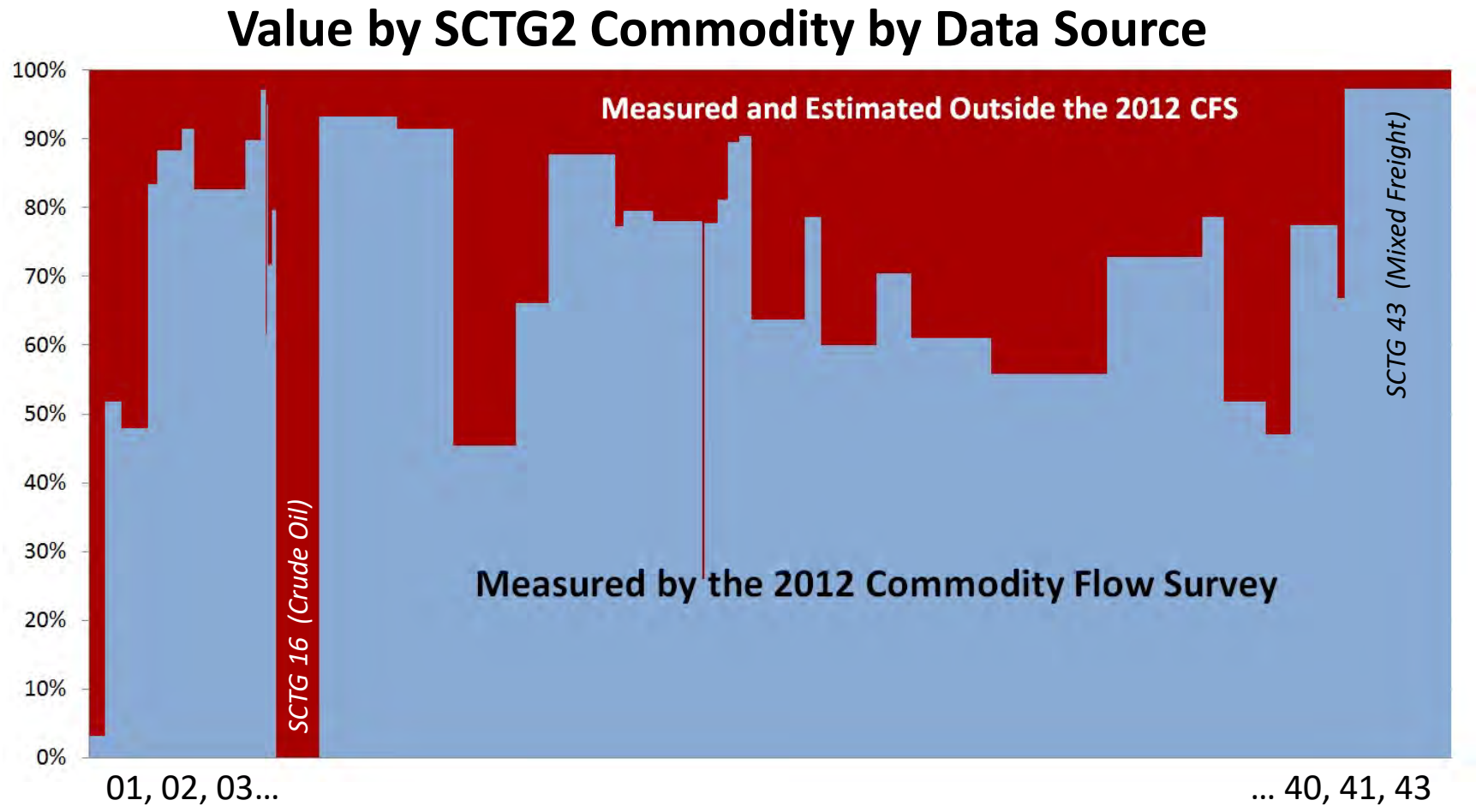


PRODUCT #2: **NETWORK FLOWS**

METHOD: **ASSIGNMENT**



About 2/3 of FAF Volumes Are Based on CFS



For more detail, see FAF Base Year Methodology Report: https://doi.org/10.2172/1844893

Additional Uses of the CFS Data

- Attraction for farm shipments
- Value-to-weight ratios
  - Construction and Demolition
  - Retail
  - Services
  - Household and business moves
- Industry contributions in the annual estimates

Limitations of FAF

- Geographic granularity → solution (in progress): disaggregate from FAF/CFS regions to county level
  - However, CFS input matrix is still very sparse
- Multimodal is one category → solution (in progress): develop method (using CFS records) to infer more path detail
- Less confidence in estimates for some Out-Of-Scope (OOS) commodities
- Weak coverage of "last mile" flows in general
  - Customer pickup: historically was bundled with delivery categories
  - E-commerce: unknown, but important for estimating vehicle miles traveled (and is needed for statewide freight plans)

Impacts of Recent CFS on FAF

- FAF6 release (Fall 2025)
  - Will use CFS 2022
- Geographic granularity → denser CFS input matrix → more confidence in high-fidelity (county level) estimates
- Multimodal is one category → more shipment records will improve our detailed path estimates
- Larger CFS sample may also improve our supplemental CFS inputs to the OOS estimation (e.g., value-to-weight ratios)
- Improved coverage of “last mile” flows
  - Customer pickup

Future Directions

- E-commerce: update CFS? Look to other Census surveys? Integrate data from BTS' planned Household Logistics Data Program?
- SCTG2: update with more and/or different categories
  - E.g., SCTG 19 contains both Asphalt and Liquefied Natural Gas
- Modernization: integrate richer set of data and potentially new methodologies
  - Example: model instead of construction for some processes; additional features to support supply chain analysis
- Fill key data gaps - e.g., cost of shipping

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THANK YOU

FAF Development Process