Freight Analysis Framework, Version 5 (FAF5):
Overview of Base Year/Forecasted Data and FAF Web-Based Tool Demonstration

July 2022

U.S. Department of Transportation
Federal Highway Administration

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Agenda

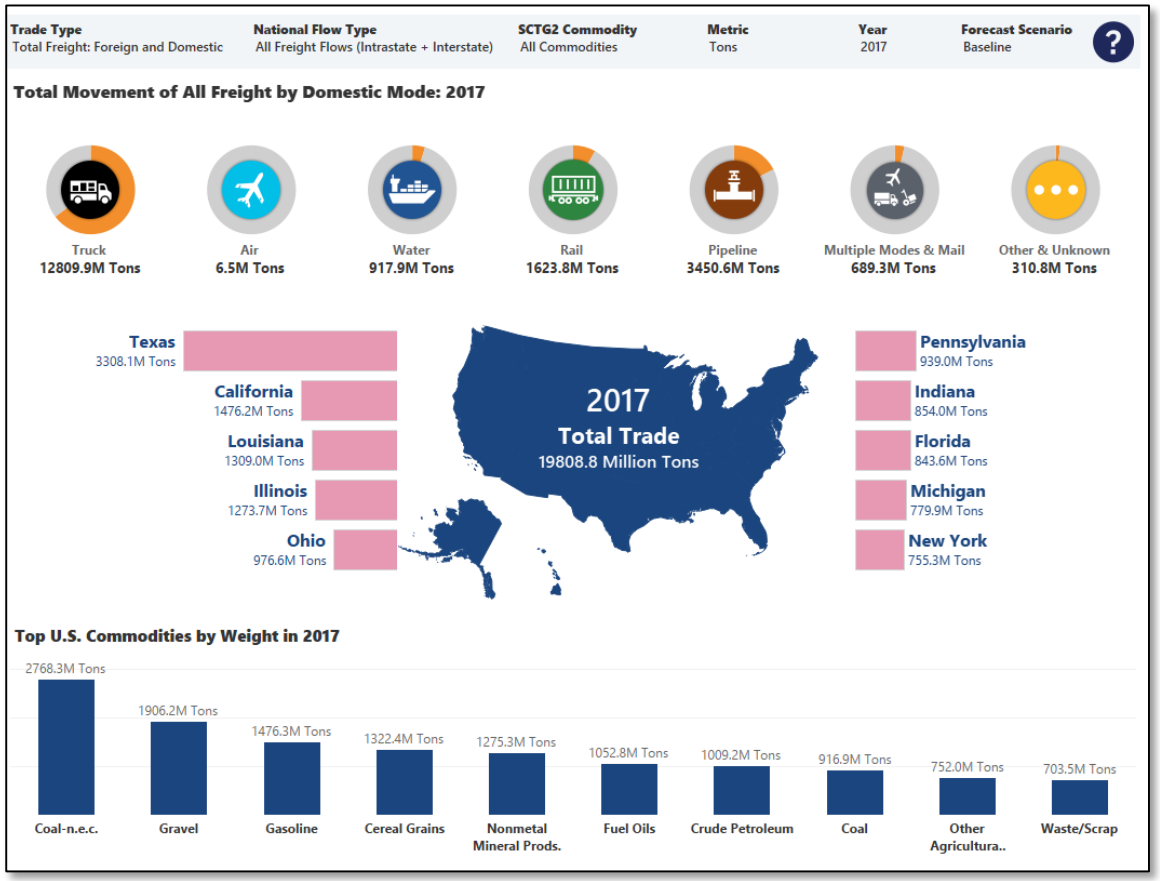
- **Overview of FAF5 & Base Year Data**
  Birat Pandey, FHWA
- **Overview of FAF5 Forecast Data**
  Paul Bingham, IHS Markit
- **FAF5 Web-Based Tool Demonstration**
  Hyeonsup Lim, Oak Ridge National Laboratory
- **Q&A**
  Facilitated by Alisa Fine, USDOT Volpe Center

Expected Learning Outcomes

- ✓ Improved understanding of FAF5 updates
- ✓ Enhanced ability to use FAF5 for freight analysis
- ✓ Increased knowledge of FAF5 web-based tools

What is FAF?

FAF5 Webpage: https://ops.fhwa.dot.gov/freight/freight_analysis/faf/



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF Provides a Comprehensive Picture of Freight Movement in the U.S.

- Includes information on:
  - Weight and value of freight transported
  - Types of commodities and transport mode
  - Freight truck routings
- Offers tools to obtain customized data for analysis
- Updated every 5 years in conjunction with economic census

What Information Does FAF5 Include?

What is Moving?
- Types of commodities

Where is it Moving?
- Between metropolitan areas
- Between States
- Between U.S. and foreign countries
- Within U.S. including States and metropolitan areas

How Much is Moving?
- Tons, ton-miles, and value of goods moved (various modes including truck, rail, air, and water)

How Much is Expected to Move (flow scenarios)?
- Base year estimates
- 30-year forecasts

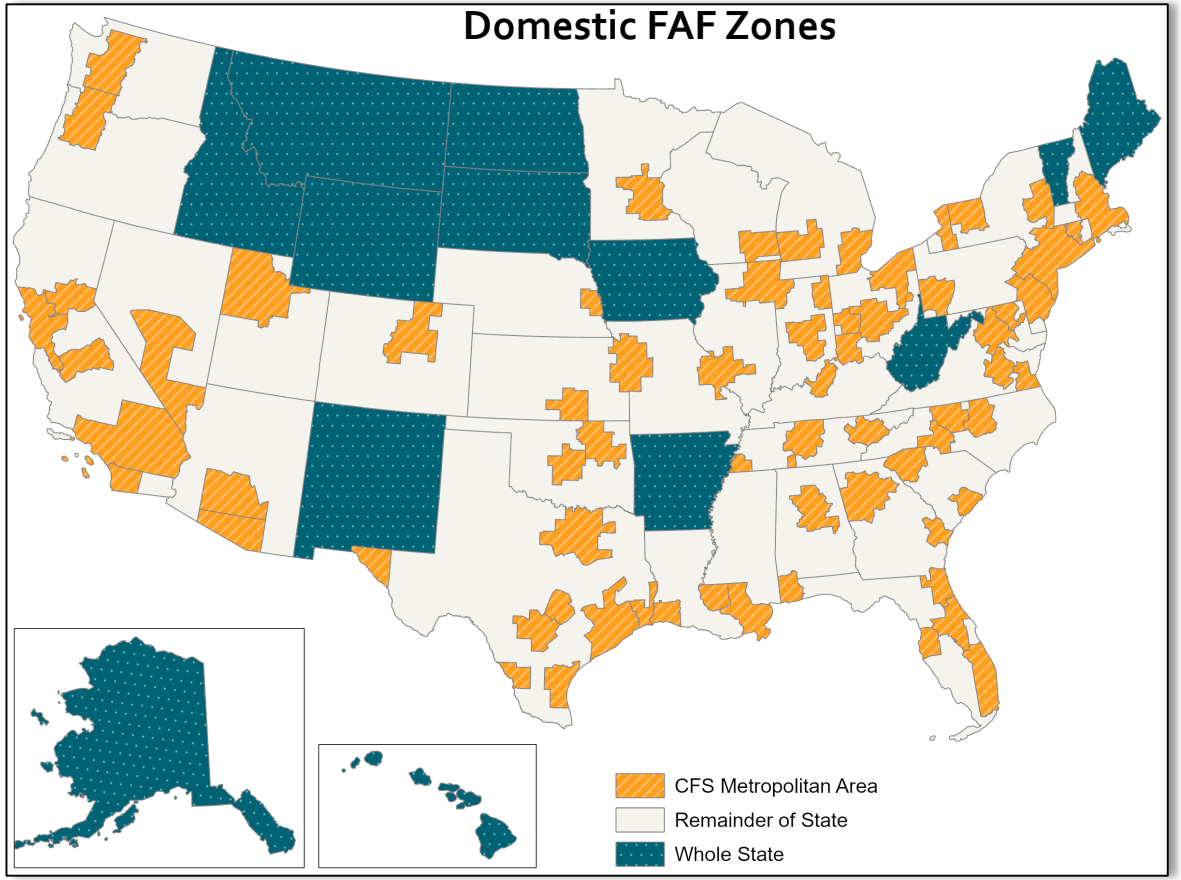
FAF Data Include:
- 42 commodity categories
- Domestic flows
- Freight exports and imports
- Weight and value by 6 transport modes
- 3 forecast scenarios

How are Geographies Represented in FAF5?

FAF Zones Include:

- Domestic zones (representing 50 States and the District of Columbia)
- International zones (8 regions):
  - Canada
  - Mexico
  - Rest of Americas
  - Europe
  - Africa
  - Southwest & Central Asia
  - Eastern Asia
  - Southeast Asia & Oceania

Additional information on FAF zones is available at: https://www.census.gov/programs-surveys/cfs.html



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.

Domestic FAF zone shapefiles are available on the FAF5 webpage at https://faf.ornl.gov/faf5/

What are FAF5 Base Year Data Sources?

Commodity Flow Survey (CFS) 2017

National survey of shippers in U.S. at FAF zone level

+

Imports and Exports

Census-provided data collected by U.S. Customs and Border Protection for U.S. gateways

+

Other Federal Data Sources

Other data such as crude petroleum data from the Energy Information Administration

=

FAF5 Base Year 2017

What Does the CFS Include?

Examples of CFS industry categories:

- Broader industry category examples (3-digit NAICS* code level):
  - Mining (except oil and gas)
  - Food manufacturing
  - Machinery manufacturing
- More granular industry category examples (4-digit NAICS code level):
  - Warehousing and storage
  - Newspaper, periodical, book, and directory publishers

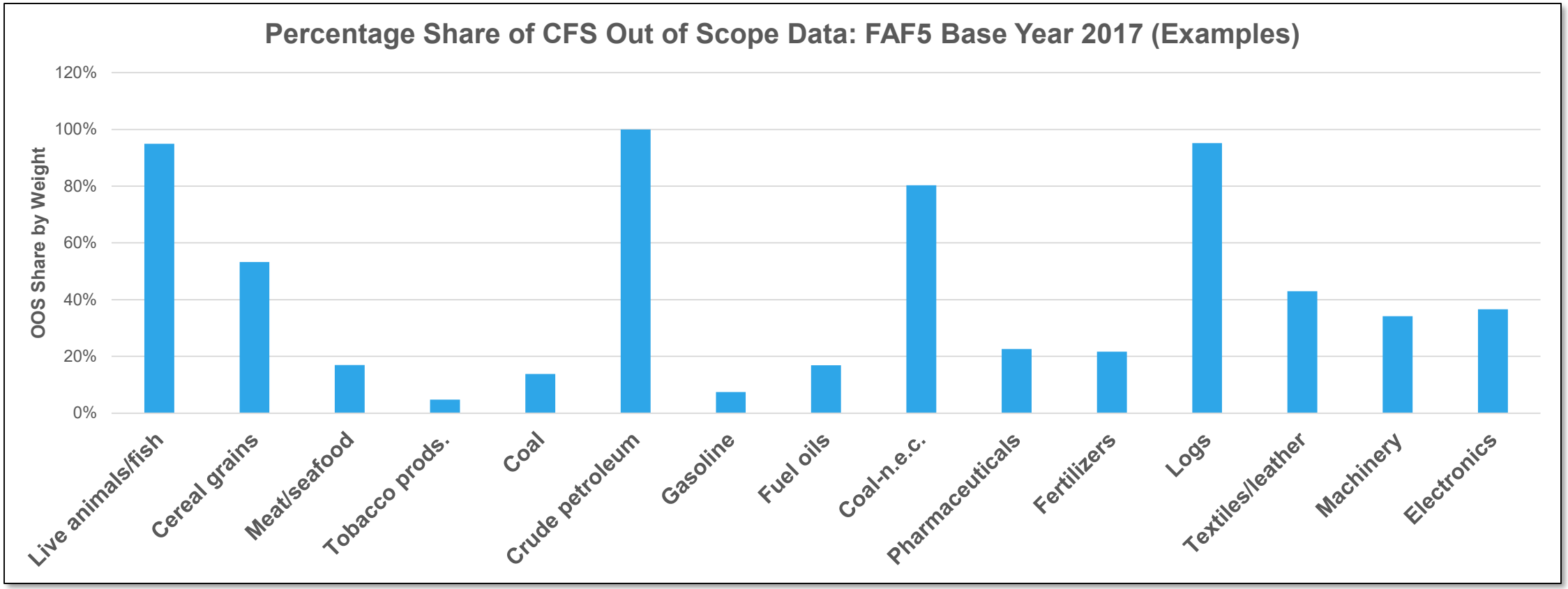
**NAICS = North American Industry Classification System*

Overview of CFS:

- Shipper-based survey that collects information on how U.S. businesses transport materials and goods; types of commodities shipped; value/weight of shipments; and other information
- Joint effort by the Bureau of Transportation Statistics, USDOT, and U.S. Census Bureau; required by law
- Includes data from approximately 100,000 businesses, representative of 5 industries: mining, manufacturing, wholesale trade, retail and services, and some auxiliary establishments (e.g., warehouses)

Additional information on the CFS is available at:
https://www.census.gov/programs-surveys/cfs/about.html

What Does the CFS Exclude?



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.1.

Additional information on CFS out of scope data for FAF5 is available from the FAF5 Base Year data development report: https://ops.fhwa.dot.gov/freight/freight_analysis/faf/

What are FAF5 Forecasted Data Sources?

Domestic Freight Model

U.S. macro economic model and U.S. regional model

+

International Freight Model

U.S. international trade and global trade model

=

FAF5 Forecasted Data

(3 growth scenarios)

What is New in FAF5?

Origin-Destination Flows

- New data base year (2017)
- Updated data to horizon 2050 with 5-year increments
- New short-term forecasts for 2020, 2022, and 2023
- Revised annual estimates for 2018 and 2019
- Updated base year data and forecast data development processes

Highway Network Flows

- Updated model highway network (dualized Interstates and included ramps)
- Added new truck flows by commodity groups
- Added new truck flows (domestic, imports, and exports)
- Overhauled highway network model and routing algorithms
- Added new customized model software and analysis capability

Special Products and Data Tools

- Updated features for web-based data products
- Added new FAF data visualization tools
- Added new national truck flow maps
- Added new State-level truck flow maps
- Added new summary tables by FAF zones
- Added a new special tabulation of CFS 2017 for small areas

What Can FAF Help Me Do?

FAF can help:

- Inform freight analysis and decision-making
- Improve understanding of current and projected future freight needs
- Enhance understanding of current and projected future freight movement
- Illuminate links between freight and economic activity
- Improve freight performance monitoring and management
- Better visualize freight flows and other freight data

Examples of FAF Use Cases:

- ✓ Support development of or updates to the State Freight Plan
- ✓ Help identify commodity corridors and trade lanes
- ✓ Provide control totals for modeling needs to understand State/regional freight connectivity
- ✓ Help conduct macro-level analysis for drafting grant applications

What Skills are Needed to Use FAF5?

- Basic understanding of origin-destination flows of vehicles or commodities
- Basic understanding of freight shippers, freight carriers, freight storage and distribution, and freight consumption
- Basic knowledge of industry inputs, outputs, and economic measures
- Basic data manipulation skills such as cross tabulation, data plotting, and understanding of basic statistical measures

FAF is designed to be user friendly.

Users do not need specialized expertise or software to access FAF data or utilize FAF tools for data customization

What are Some Considerations in Using FAF5?

FAF5 Strengths

- Publicly available and user friendly
- Trusted, long-standing Federal data source
- Considers national and international trade
- Includes multimodal perspectives
- Includes 42 commodity group types
- Forecast assumptions are balanced
- Supports analysis at multiple scales
- Supports network flow analysis on the National Highway System, higher functional class roadways, and on multicounty corridors

FAF5 Limitations

- Not tailored to a specific region
- Potential inconsistency with local growth scenarios
- Local roadways not fully captured
- May not have enough granularity for local-scale analysis; local-level analysis likely requires supplemental data
- Commodity details may be insufficient for some types of analyses

What is an Example of a FAF Output?

Example: national commodity flows and volumes

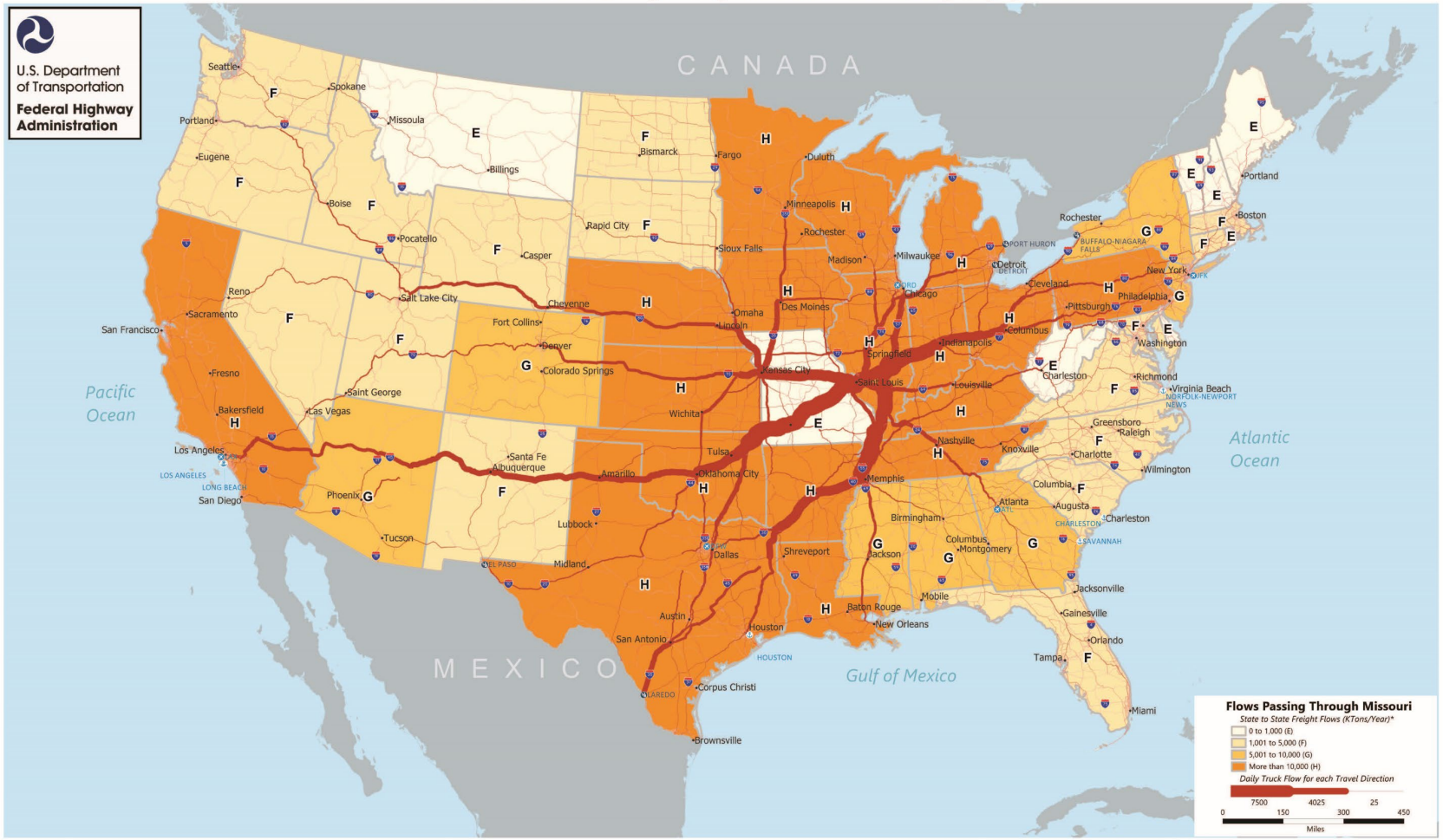
Estimated Average FAF Daily Volumes for Trucks Carrying Motorized and Other Vehicles Commodities on National Highway System 2050

Note: Major flows include domestic and international freight moving by truck on highway segments with more than 25 FAF trucks per day and between places typically more than fifty miles apart.
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.
Flows include Motorized vehicles (SCTG36) commodities represented in FAF.

What is an Example of a FAF Output?

Example: State freight through-flows

Estimated FAF Flow for Trucks Passing Through Missouri on National Highway System 2050

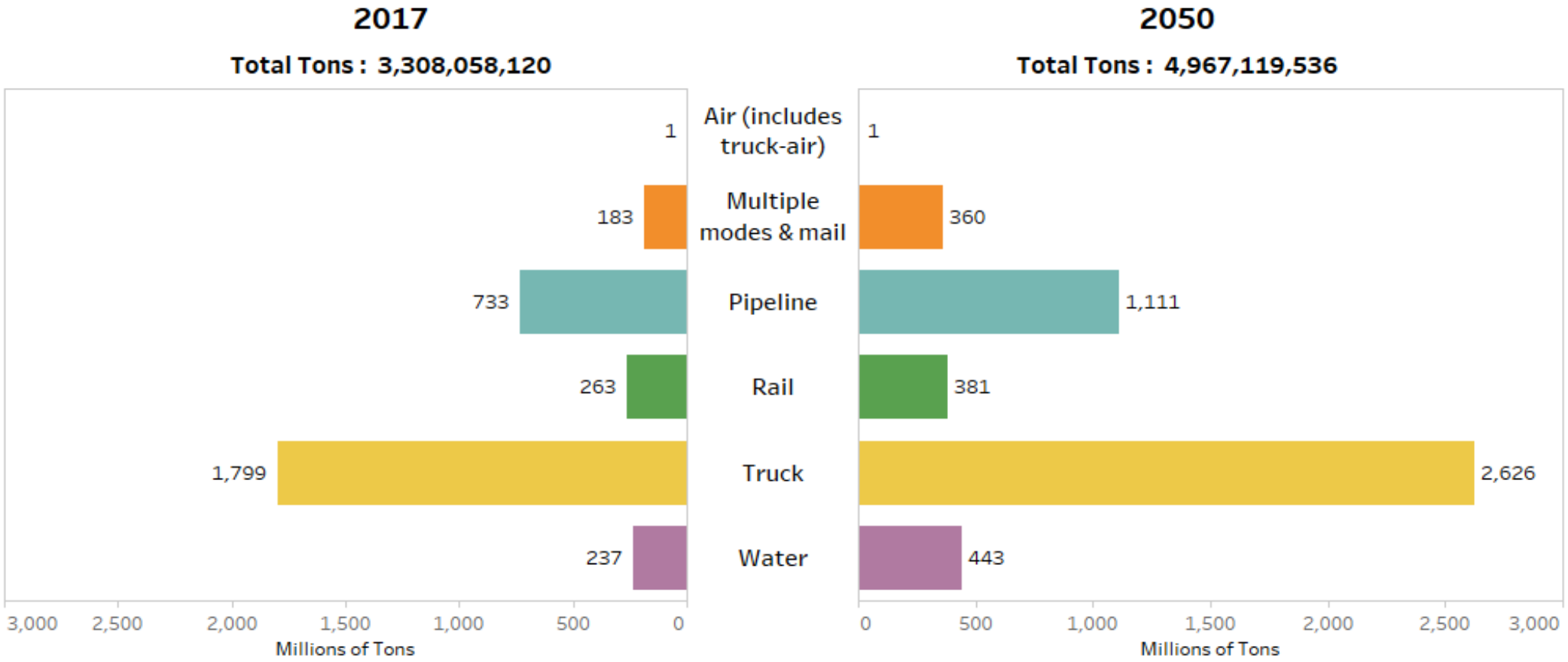


Note: Major flows include domestic and international freight moving by truck on highway segments with more than twenty-five FAF trucks per day and between places typically more than fifty miles apart.
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2. Flows include 42 different commodities represented in FAF.
*State to State flows represent annual KTons of freight transported by trucks that pass through Missouri including imports and exports that use Missouri as the gateway port.

What is an Example of a FAF Output?

Example: State freight tonnage by mode: current base year (2017) and forecasted horizon year (2050)

Texas freight tonnage by mode: 2017 and 2050*



*Note that total displayed in the bar chart above does not include the mode category: "Other."

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

What is an Example of a FAF Output?

Example: State and metro-level top trade partners

Top Five Freight Destination States for Kentucky: 2017

Origin State	Destination States	Tons (Million)	Percentage Share
Kentucky	Kentucky	160.2	49%
Kentucky	Tennessee	49.9	15%
Kentucky	Indiana	15.3	5%
Kentucky	Ohio	13.8	4%
Kentucky	South Carolina	11.7	4%
Kentucky	Remaining States	79.1	24%
Total Freight Originated in Kentucky		**330.0**	**100.0%**

Top Five Freight Destination FAF Area for Louisville Kentucky: 2017

Origin FAF Zone	Destination FAF Zone	Tons (Million)	Percentage
Louisville KY-IN (KY Part)	Louisville KY-IN (KY Part)	35.8	59%
Louisville KY-IN (KY Part)	Rest of KY	6.2	10%
Louisville KY-IN (KY Part)	West Virginia	3.0	5%
Louisville KY-IN (KY Part)	Rest of IN	2.5	4%
Louisville KY-IN (KY Part)	Nashville TN	1.0	2%
Louisville KY-IN (KY Part)	Remaning FAF Zones	12.1	20%
Total Freight Originated Louisville KY-IN (KY Part)		**60.5**	**100.0%**

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecasted Data

U.S. Department of Transportation

Federal Highway Administration

FAF5 Forecast Data Background

- FAF5 forecasts:
  - From FAF5 base year (2017)
  - Updated every 5 years like FAF base year data
  - Include forecasts out 30 years (to 2050)
- Driven by IHS Markit's commercial forecasting system of economic scenario models

FAF forecasts provide policy-makers and planners with freight demand scenarios to help analyze:

- ✓ How future freight movements impact congestion, infrastructure, safety, equity and the environment
- ✓ Impacts on freight from shifts across industries and economic geographies
- ✓ How and where to make investments to improve freight movements
- ✓ How freight will impact economic development

FAF5 Flow Data: What is Included?

FAF5 forecasts include:

- Domestic, import. and export flows
- Estimates for 2020, 2022, and 2023
- Estimated every 5 years from 2025 to 2050
- 42 Standard Classification of Transported Goods (SCTG2) commodity categories by weight and value
- Seven modes (Truck, Rail, Water, Air with Truck-Air, Multiple Modes and Mail, Pipeline, Other and Unknown)

FAF5 Forecasts: How We Do It

- Forecasts use long-term econometric forecasting modeling for economic growth scenarios
- U.S. freight activity is derived from domestic U.S. and foreign supply and demand for goods in the economy
  - U.S. macroeconomic forecasts drive multiregional input/output forecast modeling by industry sector for the U.S.
  - International country macroeconomic and industry forecasts modeling drive U.S. commodity trade forecasts by commodity

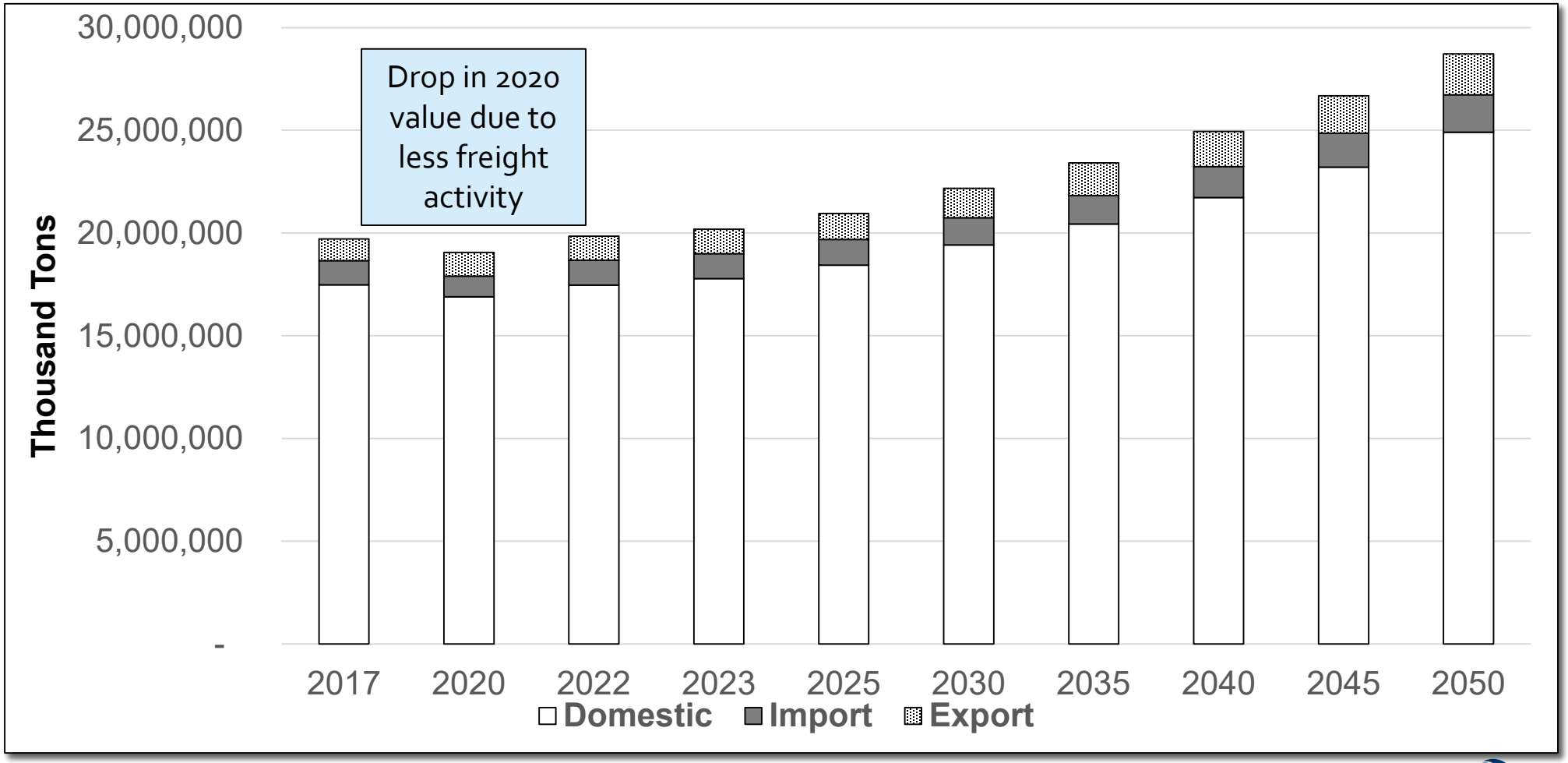
FAF5 Forecasts: Key Assumptions

- U.S. economic fundamentals remain solid for next 30 years
- Impacts of existing trade policies are assumed to continue in the future
- Sustained capital investments in technology (including automation) improve industrial productivity
- Shift in retail purchasing behavior towards e-commerce
- Increased environmental regulation of transportation
- Energy transition continues away from carbon fuels
- Less reliance on petroleum fuel tax revenues

FAF5 Forecasts and Economic Impacts

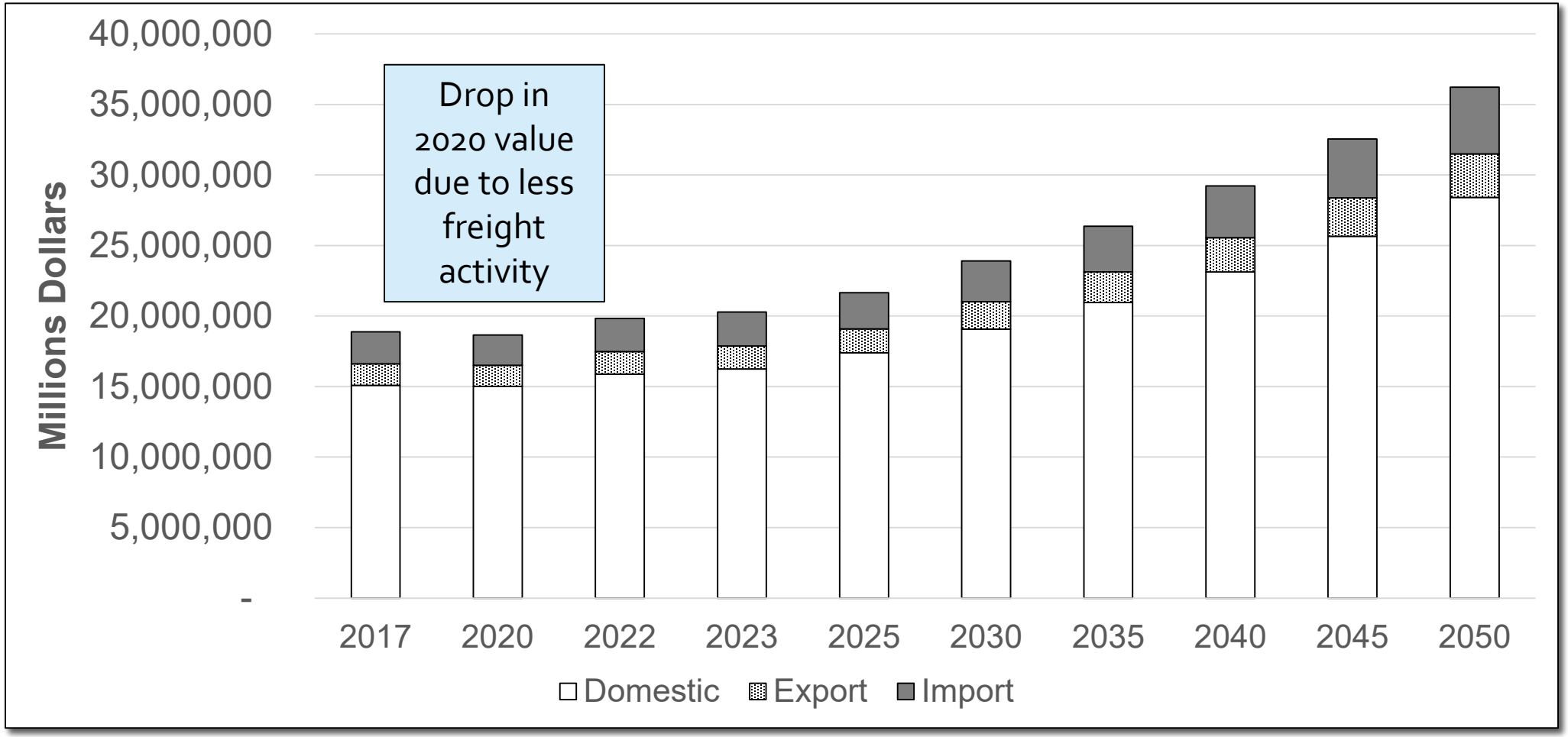
- Forecasts include available economic data as of April 2021
- Forecasts include assumptions regarding the recovery in economic activity

FAF5 Total Tonnage Forecast by Flow Type



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Total Value Forecast by Flow Type



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecast Results – Baseline Growth for Domestic Modes

Mode	Thousand Tons 2017	Thousand Tons 2050	Compound Annual Growth Rate (CAGR)
Air (includes truck-air)	2,136	4,231	2.1%
Multiple modes & mail	536,088	919,106	1.6%
Pipeline	3,132,993	4,413,841	1.0%
Rail	1,202,016	1,146,624	-0.1%
Truck	11,848,259	17,545,223	1.2%
Water	662,453	855,079	0.8%
Other and unknown	93,634	27,116	-3.7%
Total	17,477,579	24,911,219	1.1%

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecast Results – Baseline, Top 2017 Tonnage Export Commodities

SCTG2	SCTG2 Commodity	2017 Tons (Millions)	Rank 2017	2050 Tons (Millions)	Rank 2050	CAGR 2017-2050	Growth 2017-2050
15	Coal	119	1	74	12	-1.5%	-38%
18	Fuel Oils	117	2	203	1	1.7%	74%
2	Cereal Grains	103	3	152	4	1.2%	48%
3	Other Agricultural Products	75	4	132	6	1.7%	76%
19	Coal and Petroleum Products, not elsewhere classified (n.e.c.)	72	5	159	3	2.4%	121%
17	Gasoline and Aviation Turbine Fuel	68	6	136	5	2.1%	100%
16	Crude Petroleum Oil	64	7	163	2	2.9%	155%
20	Basic Chemicals	56	8	113	8	2.2%	102%
41	Waste/scrap	48	9	124	7	2.9%	158%
4	Animal feed	42	10	95	9	2.5%	126%

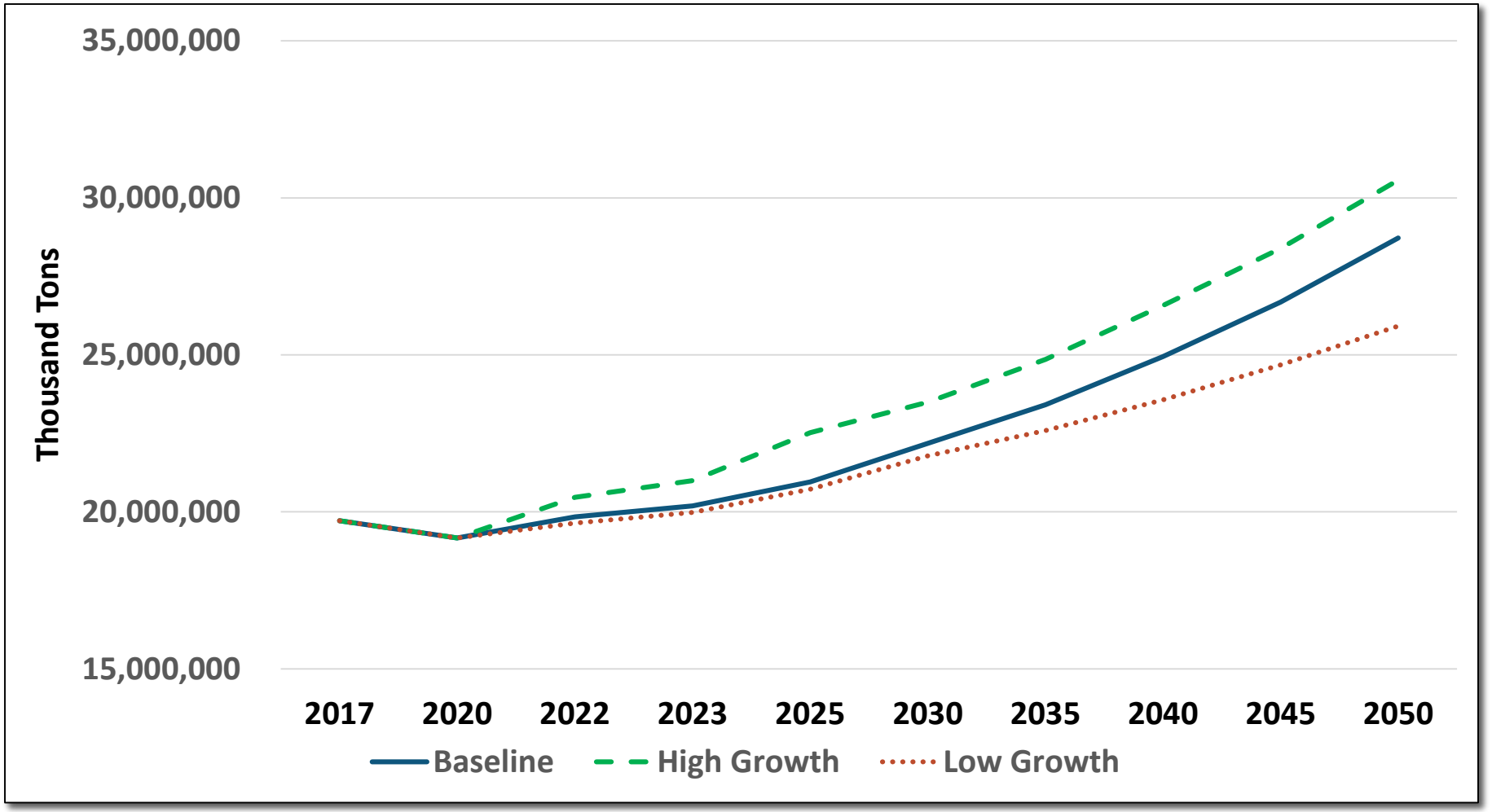
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecast Results – Baseline, Top 2017 Tonnage Import Commodities

SCTG2	SCTG2 Commodity	2017 Tons (Millions)	Rank 2017	2050 Tons (Millions)	Rank 2050	CAGR 2017-2050	Growth 2017-2050
16	Crude Petroleum	438	1	484	1	0.3%	11%
19	Coal and Petroleum Products, n.e.c.	69	2	48	10	-1.1%	-30%
18	Fuel Oils	61	3	47	11	-0.8%	-23%
32	Base Metal	45	4	69	7	1.3%	53%
17	Gasoline	42	5	36	20	-0.5%	-14%
13	Non-Metallic Minerals	36	6	105	2	3.3%	192%
31	Non-Metallic Mineral Products	34	7	39	17	0.4%	15%
36	Motorized vehicles	33	8	73	5	2.4%	121%
22	Fertilizers	31	9	103	3	3.7%	232%
20	Basic chemicals	30	10	37	18	0.6%	23%

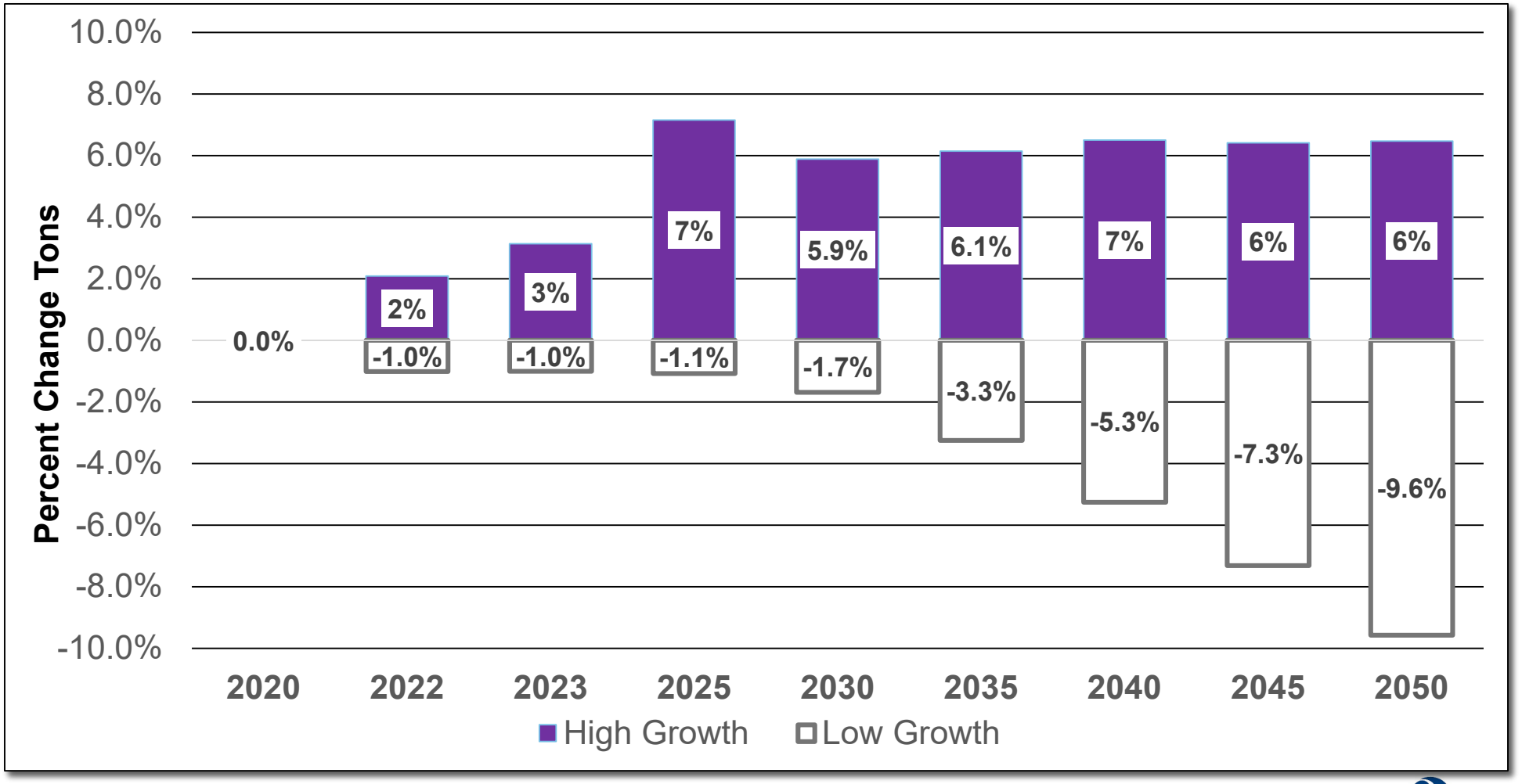
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Total Flows by Scenario



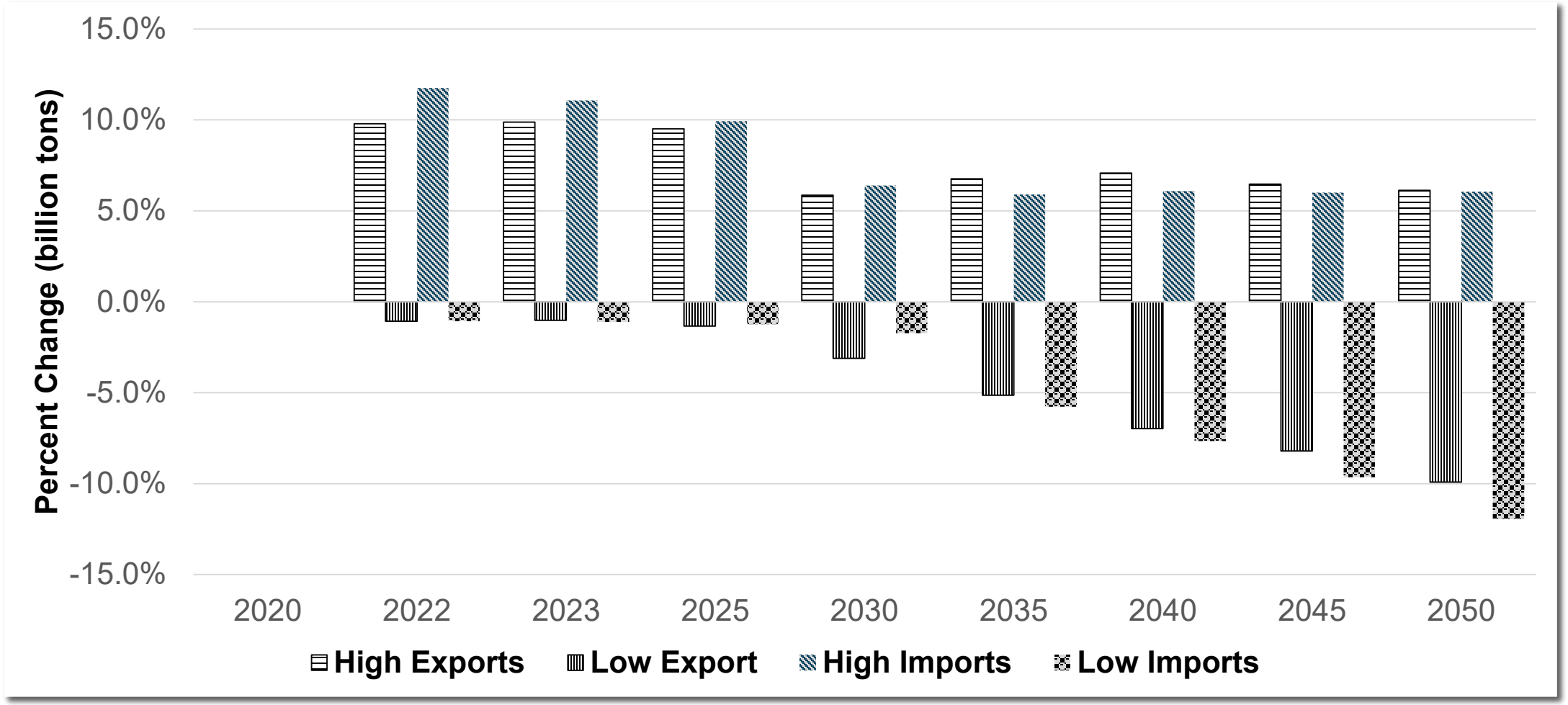
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecasts – Flow Difference Compared to Baseline Estimates



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Trade Forecasts – Difference from Baseline Scenario



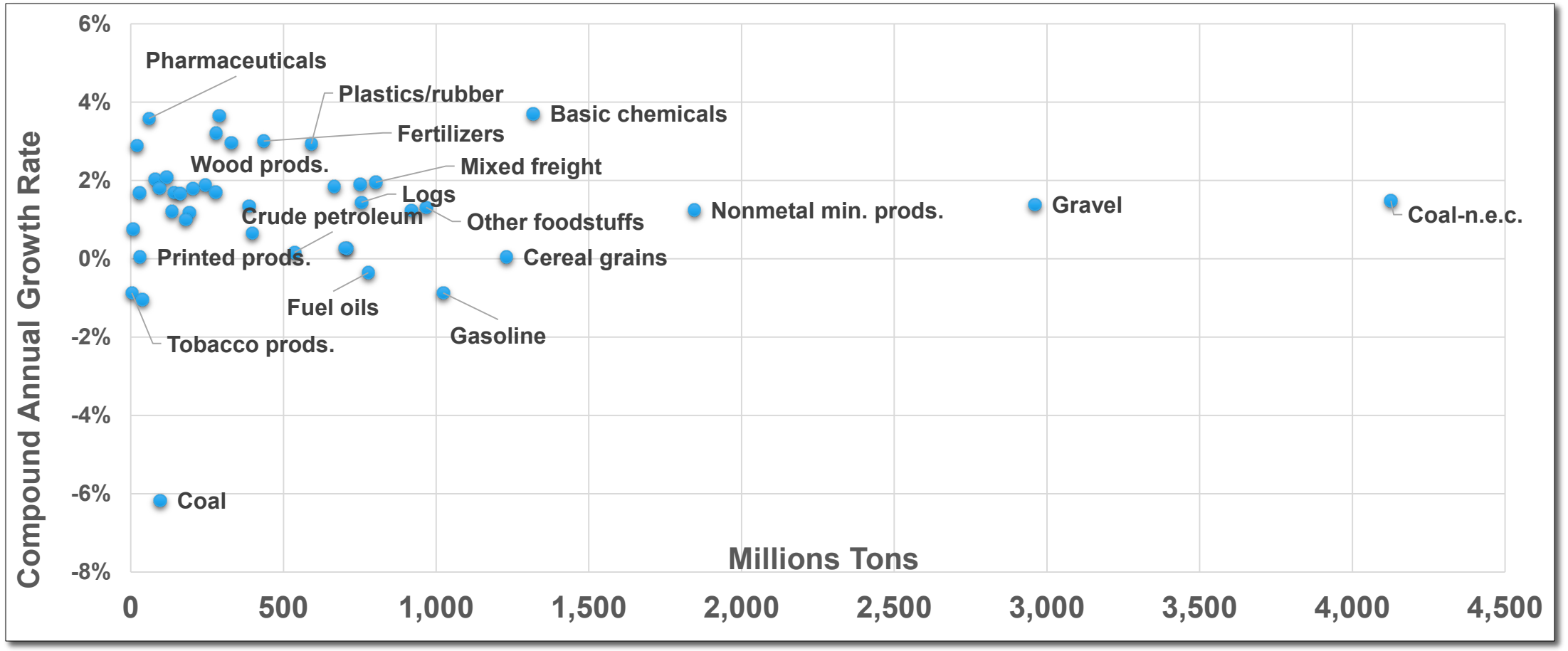
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecast Results – Baseline Top Domestic Commodity Categories

SCTG2	SCTG2 Commodity	2017 Tons (Millions)	Rank 2017	2050 Tons (Millions)	Rank 2050	CAGR 2017-2050	Growth 2017-2050
19	Coal-and Petroleum Products n.e.c.	2,538	1	4,126	1	1.5%	63%
12	Gravel	1,882	2	2,961	2	1.4%	57%
17	Gasoline	1,367	3	1,023	6	-0.9%	-25%
31	Nonmetal min. prods.	1,227	4	1,845	3	1.2%	50%
2	Cereal grains	1,211	5	1,230	5	0.05%	2%
18	Fuel oils	875	6	778	10	-0.4%	-11%
15	Coal	790	7	96	33	-6.2%	-88%
3	Other ag prods.	648	8	709	13	0.3%	9%
41	Waste/scrap	642	9	703	14	0.3%	10%
7	Other foodstuffs	628	10	967	7	1.3%	54%

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

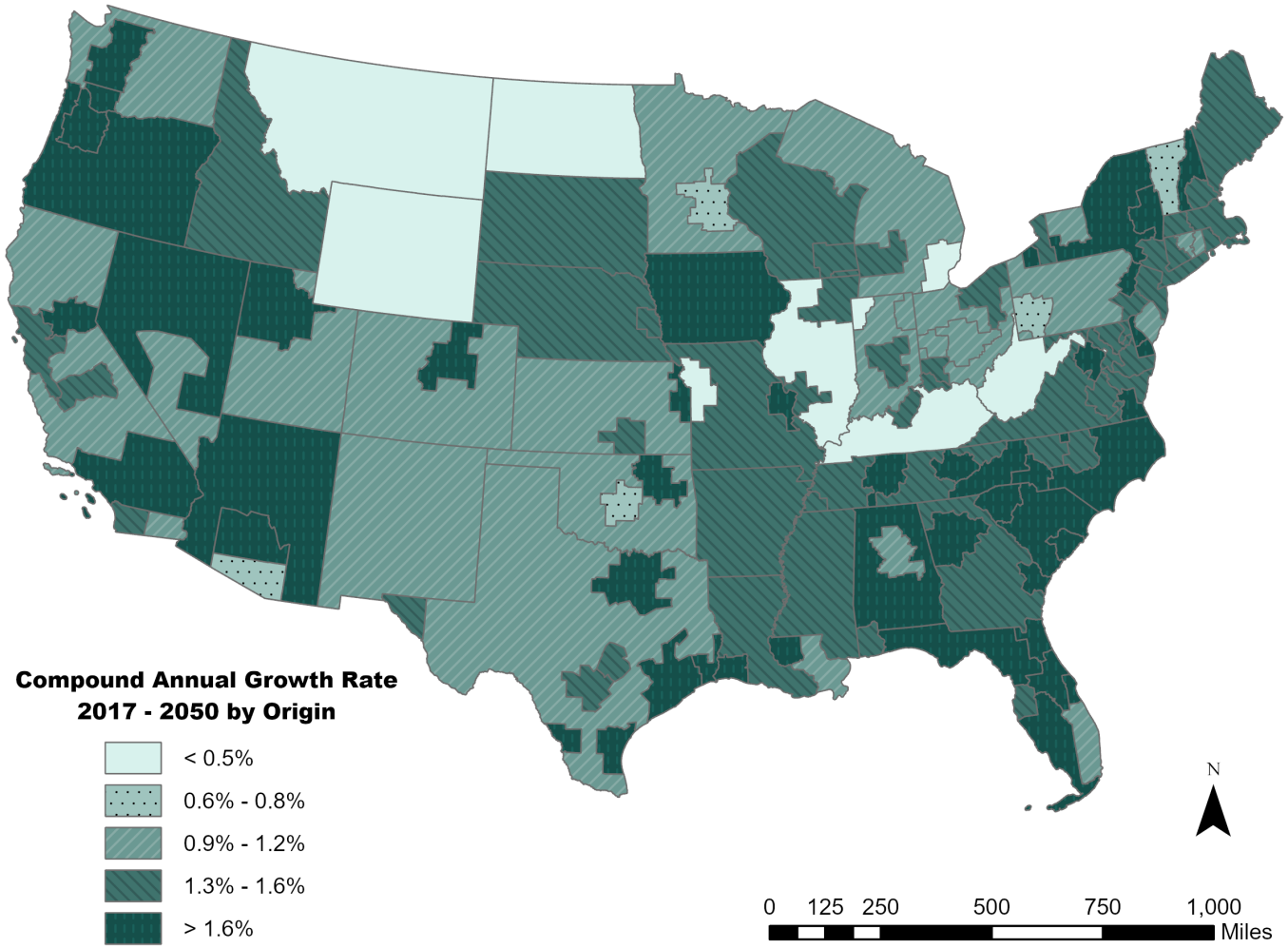
FAF5 Forecast Results – Growth Rates for all Commodities



CAGR (2017-2050) by Domestic Commodity and Tonnage

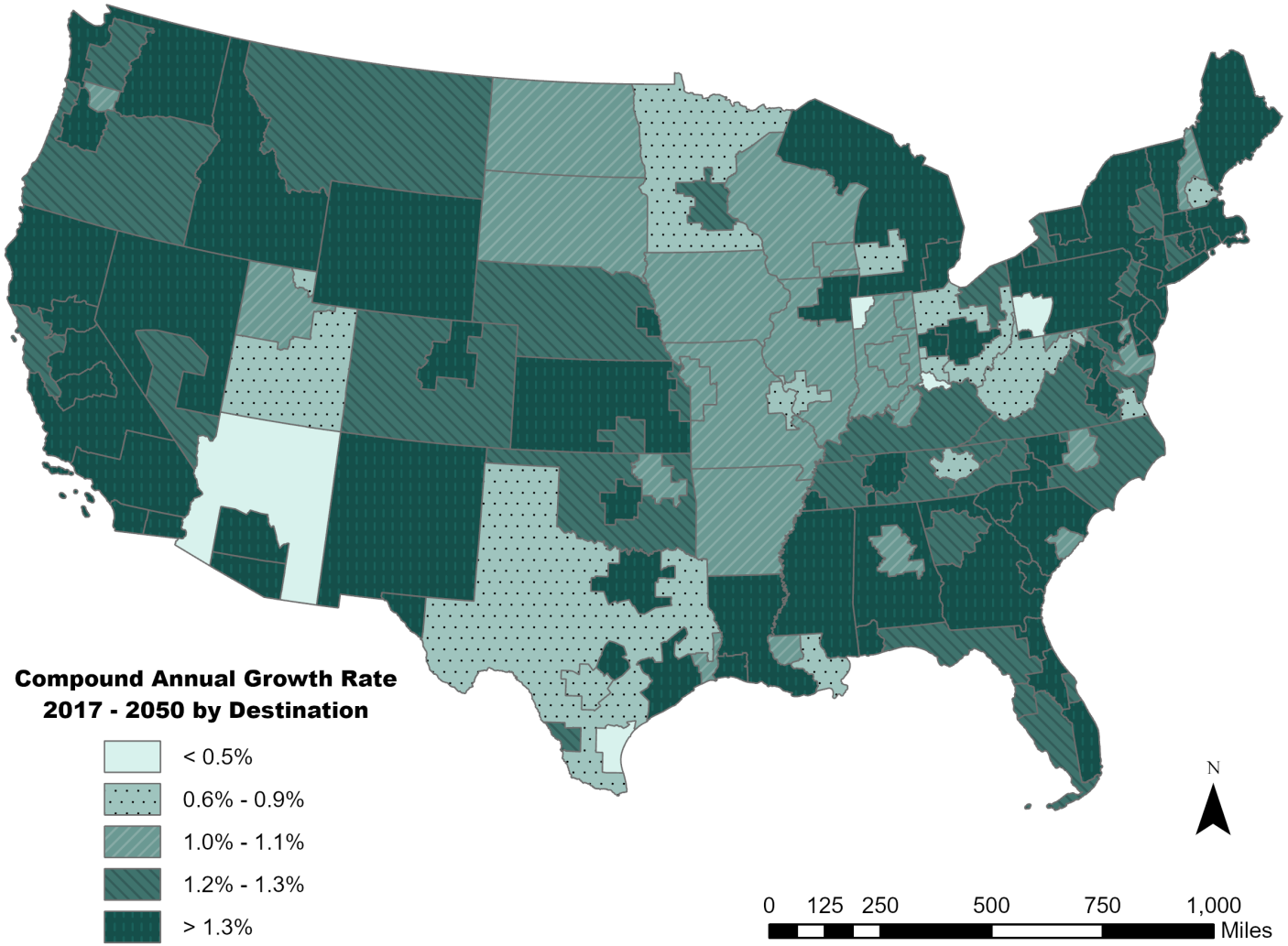
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecast Regional Growth Rates, Tonnage



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Forecast Regional Growth Rates, Tonnage



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.2.

FAF5 Web-Based Tool Demonstration

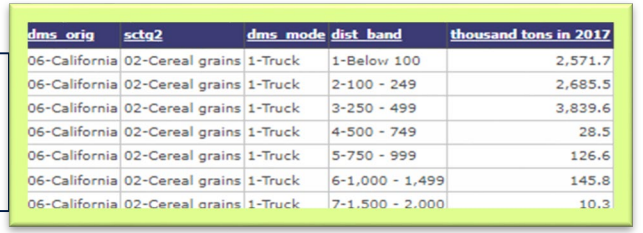
U.S. Department of Transportation
Federal Highway Administration

Overview

Data Tabulation Tool available at:
https://ops.fhwa.dot.gov/freight/freight_analysis/faf/
https://faf.ornl.gov/faf5/dtt_total.aspx

Extraction

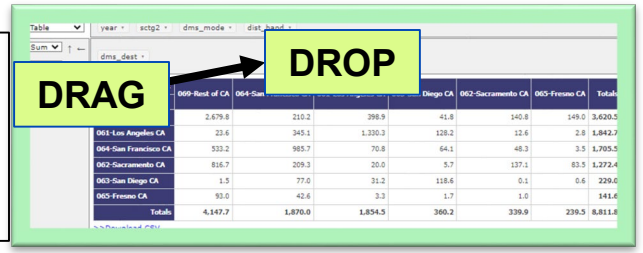
- Provides subset of data based on user selection



dms_orig	sctg2	dms_mode	dist_band	thousand tons in 2017
06-California	02-Cereal grains	1-Truck	1-Below 100	2,571.7
06-California	02-Cereal grains	1-Truck	2-100 - 249	2,685.5
06-California	02-Cereal grains	1-Truck	3-250 - 499	3,839.6
06-California	02-Cereal grains	1-Truck	4-500 - 749	28.5
06-California	02-Cereal grains	1-Truck	5-750 - 999	126.6
06-California	02-Cereal grains	1-Truck	6-1,000 - 1,499	145.8
06-California	02-Cereal grains	1-Truck	7-1,500 - 2,000	10.3

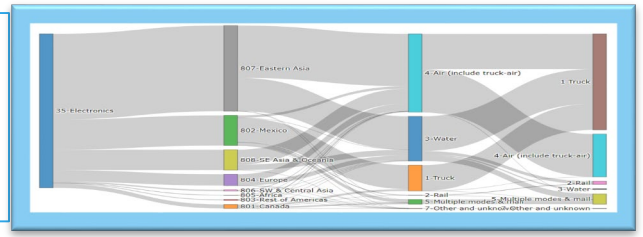
Tabulation

- Provides ability to further customize tabulation of the selected subset data.



Visualization

- Provides ability to create bar/pie charts, Sankey diagrams, origin-destination flow maps, etc.



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework (FAF), version 5.3.

Overview

Designed For:

- Querying and extracting a subset of FAF data
- Generating customized tabulation
- Visualizing simple data summaries

Not Intended For:

- Downloading the entire FAF5 dataset
  - https://ops.fhwa.dot.gov/freight/freight_analysis/faf/
- Complex data analytics
- Creating a story board

Demonstration Example

What are the major freight shipments from Texas? (by tonnage)

- Top destination State by tonnage
- Top commodities
- Mode share of each commodity
- FAF zone level origin-destination distribution

Questions?

To ask a question, you may:

- Type into the chat pod
- Choose the “raise hand” feature if you wish to ask a question by computer audio; facilitator will identify you and then unmute your line
- After the webinar:
  - Email FAF@dot.gov

FAF5 and detailed data documentation is available at:
https://ops.fhwa.dot.gov/freight/freight_analysis/faf/

Contact

Birat Pandey
Freight Analysis and Data Program Manager
birat.pandey@dot.gov

Federal Highway Administration
Office of Operations
Office of Freight Management and Operations
U.S. Department of Transportation Headquarters Building E84-444
1200 New Jersey Avenue, SE
Washington D.C., 20590