FREIGHT ANALYSIS FRAMEWORK (FAF5)
OVERVIEW, USES & IMPROVEMENTS
OVERVIEW OF FAF5
WHAT IS FAF?

- Attempt to provide a comprehensive picture of the what, where, and how of freight movement in the U.S.
- Joint program of FHWA, BTS, Census Bureau
- Updated every 5 years


FAF5 FHWA Website: [https://ops.fhwa.dot.gov/freight/freight_analysis/faf/](https://ops.fhwa.dot.gov/freight/freight_analysis/faf/)
WHAT INFORMATION IS INCLUDED IN FAF5?

- What / how much is moving?
  - 42 commodities
  - Tons, ton-miles, value of goods moved

- Where is it moving?
  - 132 FAF / CFS zones
  - Between states, metros, and abroad

- How is it moving?
  - 6 freight modes

- When is it moving?
  - 2017 base year & 3 forecast scenarios

CFS & OOS

- **Commodity Flow Survey (CFS)**
  - Shipper-based survey
  - Conducted by Census, jointly administered by BTS
  - Includes data from approximately 100,000 businesses, representative of key freight industries:
    - mining,
    - manufacturing,
    - wholesale trade,
    - retail and services, and some auxiliary establishments (e.g., warehouses)
  - Source for ~70% of FAF tonnage

- **Out-of-Scope (OOS)**
  - Commodity data from other sources
  - Key commodities (>50% OOS)
    - Crude petroleum
    - Logs
    - Coal-n.e.c.
    - Live animals/fish
    - Cereal grains
  - Other Commodities (>30% OOS)
    - Textiles/leather
    - Machinery
    - Electronics
NEW IN FAF5!

**Origin-Destination Flows**
- New database 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
FAF5 FORECAST SCENARIOS

FAF5 EXAMPLES
TRUCKS TO, FROM, & WITHIN TENNESSEE, 2017
**TOP 5 TRADING PARTNERS: TN**

- Same states, but different ordering than in FAF4

<table>
<thead>
<tr>
<th>State</th>
<th>KTons</th>
<th>Percent of Total TN Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennessee</td>
<td>211,879.0</td>
<td>58.7%</td>
</tr>
<tr>
<td>Alabama</td>
<td>31,673.1</td>
<td>8.8%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>19,522.3</td>
<td>5.4%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>15,851.9</td>
<td>4.4%</td>
</tr>
<tr>
<td>Georgia</td>
<td>12,387.9</td>
<td>3.4%</td>
</tr>
<tr>
<td>Top 5 Total</td>
<td>291,314.1</td>
<td>80.8%</td>
</tr>
</tbody>
</table>
### TOP 10 COMMODITIES

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Tons</th>
<th>Commodity</th>
<th>Tons</th>
<th>Commodity</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>64,095.8</td>
<td>Coal-n.e.c.</td>
<td>39,328.0</td>
<td>Coal-n.e.c.</td>
<td>46,103.2</td>
</tr>
<tr>
<td>Gasoline</td>
<td>22,699.7</td>
<td>Other ag prods.</td>
<td>7,825.5</td>
<td>Coal</td>
<td>10,745.1</td>
</tr>
<tr>
<td>Nonmetal min. prods.</td>
<td>18,650.6</td>
<td>Coal</td>
<td>7,546.8</td>
<td>Base metals</td>
<td>8,488.0</td>
</tr>
<tr>
<td>Coal-n.e.c.</td>
<td>12,720.9</td>
<td>Cereal grains</td>
<td>6,915.3</td>
<td>Gasoline</td>
<td>7,191.0</td>
</tr>
<tr>
<td>Waste/scrap</td>
<td>10,511.9</td>
<td>Basic chemicals</td>
<td>6,877.1</td>
<td>Other foodstuffs</td>
<td>6,950.5</td>
</tr>
<tr>
<td>Fuel oils</td>
<td>8,795.1</td>
<td>Gravel</td>
<td>6,763.4</td>
<td>Plastics/rubber</td>
<td>6,139.5</td>
</tr>
<tr>
<td>Natural sands</td>
<td>8,539.2</td>
<td>Mixed freight</td>
<td>6,744.1</td>
<td>Mixed freight</td>
<td>5,786.4</td>
</tr>
<tr>
<td>Logs</td>
<td>7,924.2</td>
<td>Base metals</td>
<td>6,720.9</td>
<td>Wood prods.</td>
<td>5,622.8</td>
</tr>
<tr>
<td>Other ag prods.</td>
<td>5,762.9</td>
<td>Nonmetal min. prods.</td>
<td>5,431.5</td>
<td>Basic chemicals</td>
<td>5,457.1</td>
</tr>
<tr>
<td>Other foodstuffs</td>
<td>5,239.5</td>
<td>Other foodstuffs</td>
<td>5,375.9</td>
<td>Nonmetal min. prods.</td>
<td>4,196.0</td>
</tr>
</tbody>
</table>
TOP COMMODITIES FROM TN BY MODE

Commodity

12-Gravel
19-Coal-n.e.c.
17-Gasoline
31-Nonmetal min. prod.
03-Other ag prod.
02-Cereal grains
20-Basic chemicals
43-Mixed freight
07-Other foodstuffs

Total weight of shipments (KTons)

70k
60k
50k
40k
30k
20k
10k
0

Legend:
- 7-Other and unknown-47-Tennessee
- 4-Air (include truck-air)-47-Tennessee
- 5-Multiple modes & mail-47-Tennessee
- 2-Rail-47-Tennessee
- 3-Water-47-Tennessee
- 6-Pipeline-47-Tennessee
- 1-Truck-47-Tennessee
TONNAGE ORIGINATING IN TN BY MODE & YEAR

Total weight of shipments by dms_mode and year

- 7-Other and unknown
- 4-Air (include truck-air)
- 3-Water
- 5-Multiple modes & mail
- 2-Rail
- 6-Pipeline
- 1-Truck
CALIPER’S ROLE IN FAF5
FAF NETWORK FLOWS

- The objective: to maximize the usefulness of the FAF5 data by disaggregating it to a more fine-grained zone system and by assigning those flows to a national road network.
FAF5 OBJECTIVES

- More accurate truck flows
- More transparent process
- Robust querying tools for understanding commodity flows over the national network
DISAGGREGATION OF COMMODITY FLOWS

- From 132 FAF zones to 3599 zones
  - Counties, sub-county for large counties, ports, airports, and border crossings
  - Commodity production & consumption functions
  - Tri-proportional gravity model to preserve aggregate FAF OD flows
NEW NATIONAL NETWORK

- 580,000 route miles
- All NHS, STRAHNET and NHFN routes designated
- Fully routable with centroid connectors
- Congested speeds from NPMRDS where applicable
- Truck tolls compiled for 2017
NEW TRUCK ASSIGNMENT BY ROUTE CHOICE

- Intercity truck flows are not based on equilibrium
- Relevant alternative routes are enumerated
  - Routes can be viewed, edited, deleted & added
- Path-size logit is used to allocate shares to routes
- Path choices are based on congested travel times and tolls
- Limited calibration and validation to ATRI data

\[ f_p = \frac{e^{\beta \cdot \text{time}_p + \gamma \cdot \text{toll}_p + \delta \ln(S_p)}}{\sum_{p'} e^{\beta \cdot \text{time}_{p'} + \gamma \cdot \text{toll}_{p'} + \delta \ln(S_{p'})}} \]
PATH ENUMERATION

- Up to four paths generated for each OD pair
- Example: Lubbock, TX to Houston, TX
ATRI VALIDATION

- Example: Memphis and Atlanta

<table>
<thead>
<tr>
<th>ATRI</th>
<th>FAF4</th>
<th>FAF5</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.7%</td>
<td>100%</td>
<td>69.0%</td>
</tr>
<tr>
<td>15.9%</td>
<td>0%</td>
<td>13.4%</td>
</tr>
<tr>
<td>4.1%</td>
<td>0%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>
ATRI VALIDATION

- Example: Nashville and Baltimore

<table>
<thead>
<tr>
<th></th>
<th>ATRI</th>
<th>FAF4</th>
<th>FAF5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>75.6%</td>
<td>100%</td>
<td>77.8%</td>
</tr>
<tr>
<td>Purple</td>
<td>2.4%</td>
<td>0%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Orange</td>
<td>2.4%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
NATIONAL TRUCK FLOWS

Estimated Average FAF Daily Volumes for Trucks on National Highway System 2017

Note: Major flows include domestic and international freight moving by truck on highway segments with more than 25 MPH trucks per day and between places typically more than fifty miles apart.


Routes include 62 different commodities represented in FAF.
TRUCKS CARRYING STONE, GRAVEL, ORES
DURABLE GOODS ON I-80 IN IOWA
CONSIDERATIONS FOR 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
CONTACTS

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