# Modeling a Biofuel Supply Chain Between Urban Centers


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# Supply Chain Management - Overview



Courtesy of Griffin & Co Strategic

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# Logistics Optimization Modeling Objectives

- Develop a bottoms up analysis for the Carinata supply chain in order to produce jet fuel, diesel, naphtha
- Use FTOT to optimize logistics costs and determine optimal routes and modes between supply chain facilities such as:
  - Handlers
  - Crushers
  - Bio refineries
  - End user (airports, etc.)


Courtesy of SPARC

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# Logistics Optimization Modeling FTOT Overview

- FTOT was developed by USDOT Volpe National Transportation Systems Center in 2015 (previous versions exist)
- Draws data from Fuel Production Assessment Tool (FPAT) which has contributions from several universities and organizations
- Its purpose is to evaluate various costs associated with fulfilling demands for alternative fuels
- Current and future scenarios can be modeled to identify patterns, needs, opportunities, and impacts associated with alternative fuels
- Produce an “optimal” supply chain network

Courtesy of USDOT Volpe Transportation Center

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# Logistics Optimization Modeling Methodology

**Step 1: Set Origins and Ultimate Destinations**

**Step 2: Locate Potential Processing Points (e.g., biorefineries)**

- "En-route" from origins to destinations
- Minimum amount of material needed
- Existing facilities

**Step 3: Identify Best Routes for Each Origin-Destination Pair**

- Transport cost
- Transloading cost
- Weightings / preferences

**Step 4: Optimize Movements**

- Minimize scenario "cost" (incl. weightings)
- Select among biorefineries
- Optimize routing

Courtesy of USDOT Volpe Transportation Center

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# Logistics Optimization Modeling Structure

- Two modules are responsible for generating candidates and optimizing routes for minimal transportation costs

- These modules constantly hand data back and forth during analysis
  - GIS module handles location-based calculations and generates potential routes and bio refinery locations
  - Optimization module evaluates candidates and determines optimal route with lowest penalties and monetary costs

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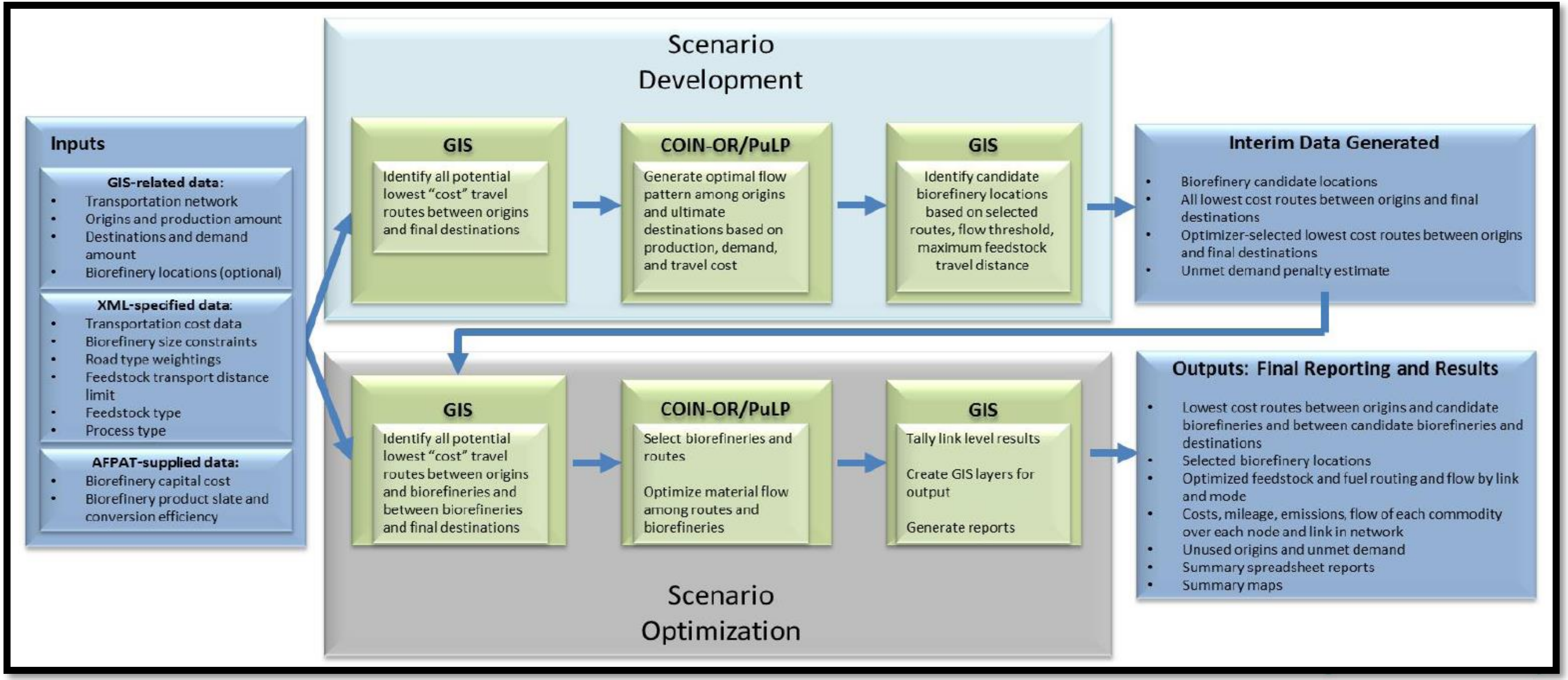
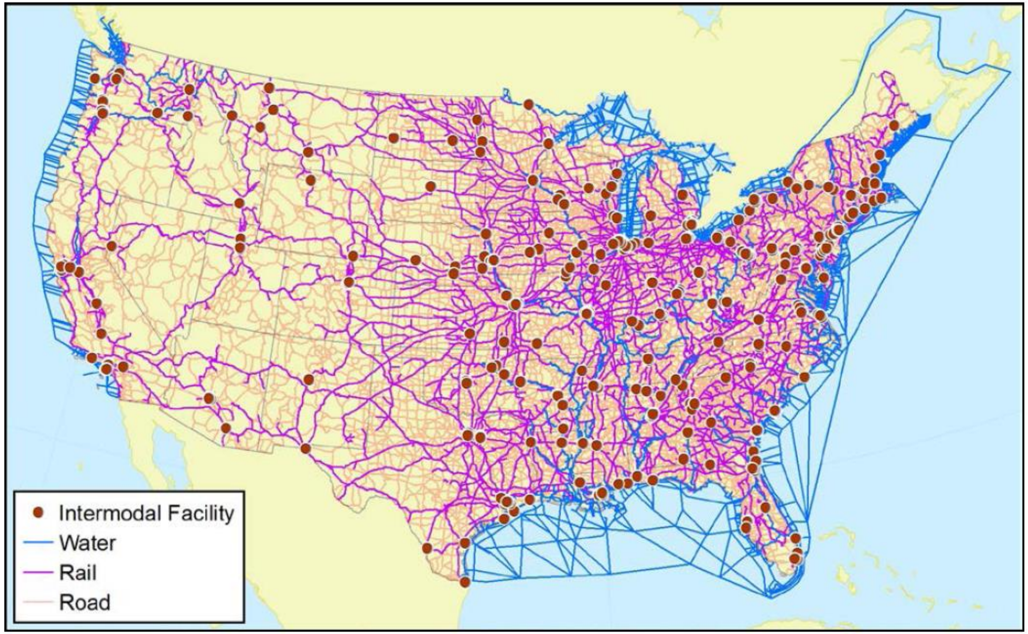
# Logistics Optimization Modeling Structure




Courtesy of USDOT Volpe Transportation Center

# Logistics Optimization Modeling Inputs/Data

- Input GIS network layers for all available modes
  - Road (Truck)
  - Rail
  - Water (Seaborne and Barge)
  - Pipeline




Courtesy of USDOT Volpe Transportation Center

# Logistics Optimization Modeling Scenario Development

| Supply Chain Element | Data input file | Input | Output |
|---|---|---|---|
| **Origins**: | rmp.csv | N/A | Grease |
| **Origins**: | rmp.csv | N/A | Carinata_oilseed_bulk |
| **First processing point**: | proc.csv | Carinata_oilseed_bulk | Carinata_oil_crude |
| **Second processing point:** | proc.csv | Grease<br>Carinata_oil_crude | Jet, diesel, naphtha |
| **Final destinations Type 1:** | dest.csv | Jet fuel, diesel, naphta | N/A |

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# Logistics Optimization Modeling Scenario Development

| | ARA and CAAFI Developed/Requested Scenarios | | | |
|---|---|---|---|---|
| **Supply Chain Element** | **1** | **2** | **3** | **4** |
| **Origins**: | Kissimmee, FL Location | Kissimmee, FL Location | Houston, TX | Kissimmee, FL Location |
| **Origins**: | RMP Handler Locations | RMP Handler Locations | RMP Handler Locations | RMP Handler Locations |
| **First processing point**: | Express Grain, MS | Express Grain, MS | Express Grain, MS | Express Grain, MS |
| **Second processing point:** | Sunshine (Tampa) | Sunshine (Tampa) | Pascagoula, MS | Valdosta,GA |
| **Final destinations Type 1:** | Jet - MCO; Diesel - Los Angeles CA; Naphtha - Des Moines, Iowa | Jet - TPA; Diesel - Los Angeles CA; Naphtha - Des Moines, Iowa | Jet - Airbus at Mobile, AL Downtown Airport; Diesel - Los Angeles CA; Naphtha - Des Moines, Iowa | Jet - SAV; Diesel - Los Angeles CA; Naphtha -Des Moines, Iowa |

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# Logistics Optimization Modeling Scenario Development

| | Agrisoma Developed/Requested Scenarios | | | |
|---|---|---|---|---|
| **Supply Chain Element** | **5** | **6** | **7** | **8** |
| **Origins**: | Kissimmee, FL Location | N/A | N/A | Kissimmee, FL Location |
| **Origins**: | RMP Handler Locations | RMP Handler Locations | RMP Handler Locations | RMP Handler Locations |
| **First processing point**: | Express Grain, MS | Express Grain, MS | ADM RedWing, MN | Express Grain, MS |
| **Second processing point:** | ARA Facility; Tampa FL | REG Refinery Geismar, LA | Andeavor Refinery Dickinson, ND | REG Refinery Geismar, LA |
| **Final destinations Type 1:** | Jet - TPA; Diesel - Los Angeles CA; Naphtha -Des Moines, Iowa | Jet - LAX; Diesel - Los Angeles; Naphtha - Los Angeles | Jet - SFO; Diesel - Vancouver; Naphtha - Seattle | Jet - IAH and /DFW; Diesel -Vancouver; Naphtha - Vancouver |

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# Logistics Optimization Modeling – Optimal Supply Chain Solution

| Facility_name | Facility_type | Commodity |
|---|---|---|
| RMP:GLHORNHOUSTON | raw_material_producer | grease |
| RMP:PRTWLLHOUSTON | raw_material_producer | grease |
| RMP:AUSTIN | raw_material_producer | grease |
| RMP:ELLTROUTLUFKIN | raw_material_producer | grease |
| RMP:LAFAYETTE | raw_material_producer | grease |
| HAND:CRGLLMONTGO | raw_material_producer | carinata_oil_seed_bulk |

| Facility_name | Facility_type | Commodity |
|---|---|---|
| BREF:CHVRNMS | Biorefinery | carinata_oil_crude |
| BREF:CHVRNMS | Biorefinery | grease |
| BREF:CHVRNMS | Biorefinery | jet |
| BREF:CHVRNMS | Biorefinery | diesel |
| BREF:CHVRNMS | Biorefinery | naphtha |
| PROC:CRGLLMONTGO | Crusher | carinata_oil_seed_bulk |
| PROC:CRGLLMONTGO | Crusher | carinata_oil_crude |

| Facility_name | Facility_type | Commodity |
|---|---|---|
| DEST:LAX | ultimate_destination | Jet |
| DEST:CHEVCA | ultimate_destination | Diesel |
| DEST:SWGAETH | ultimate_destination | Naphtha |
| DEST:TATELYLE | ultimate_destination | Naphtha |
| DEST:ADM | ultimate_destination | Naphtha |

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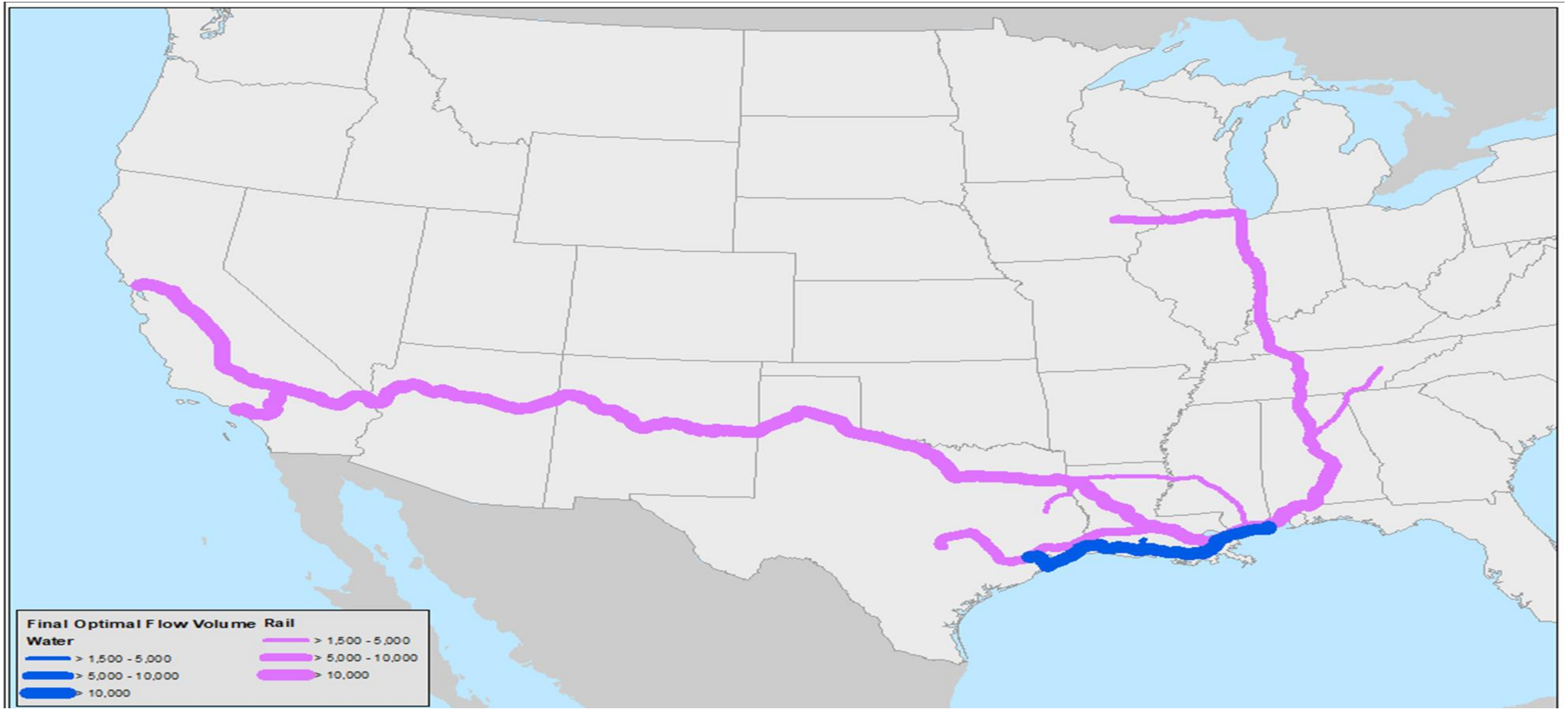
# Logistics Optimization Modeling – Optimal Supply Chain Network

# Logistics Optimization Modeling – Volumes (Gal.) on Optimal Network



# Summary of Scenarios – Optimized Total Cost & CO2 Emissions

| SPARC Scenario # | Total $CO_2$ Emissions (Kg) | Total Dollar Cost (USD) |
|---|---|---|
| Scenario (1) | 24,363,761 | 35,120,617 |
| Scenario (2) | 21,585,050 | 29,573,722 |
| Scenario (3) | 19,958,689 | 28,137,663 |
| Scenario (4) | 34,201,716 | 44,701,612 |
| Scenario (5) | 23,827,896 | 28,326,489 |
| Scenario (6) **Carinata only* | 14,047,265 | 18,737,736 |
| Scenario (7) | 23,037,417 | 31,905,705 |
| Scenario (8) | 29,008,157 | 43,593,692 |

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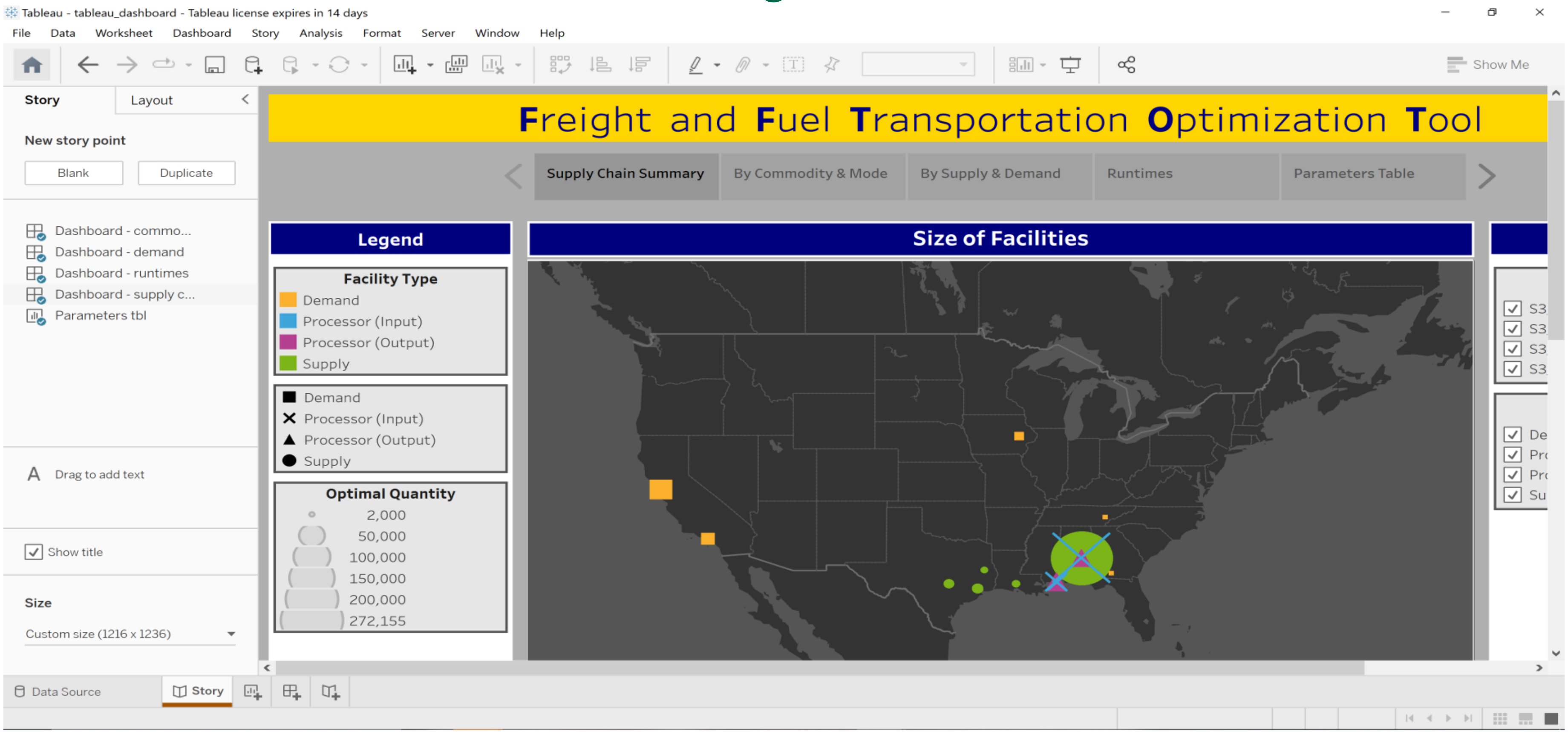
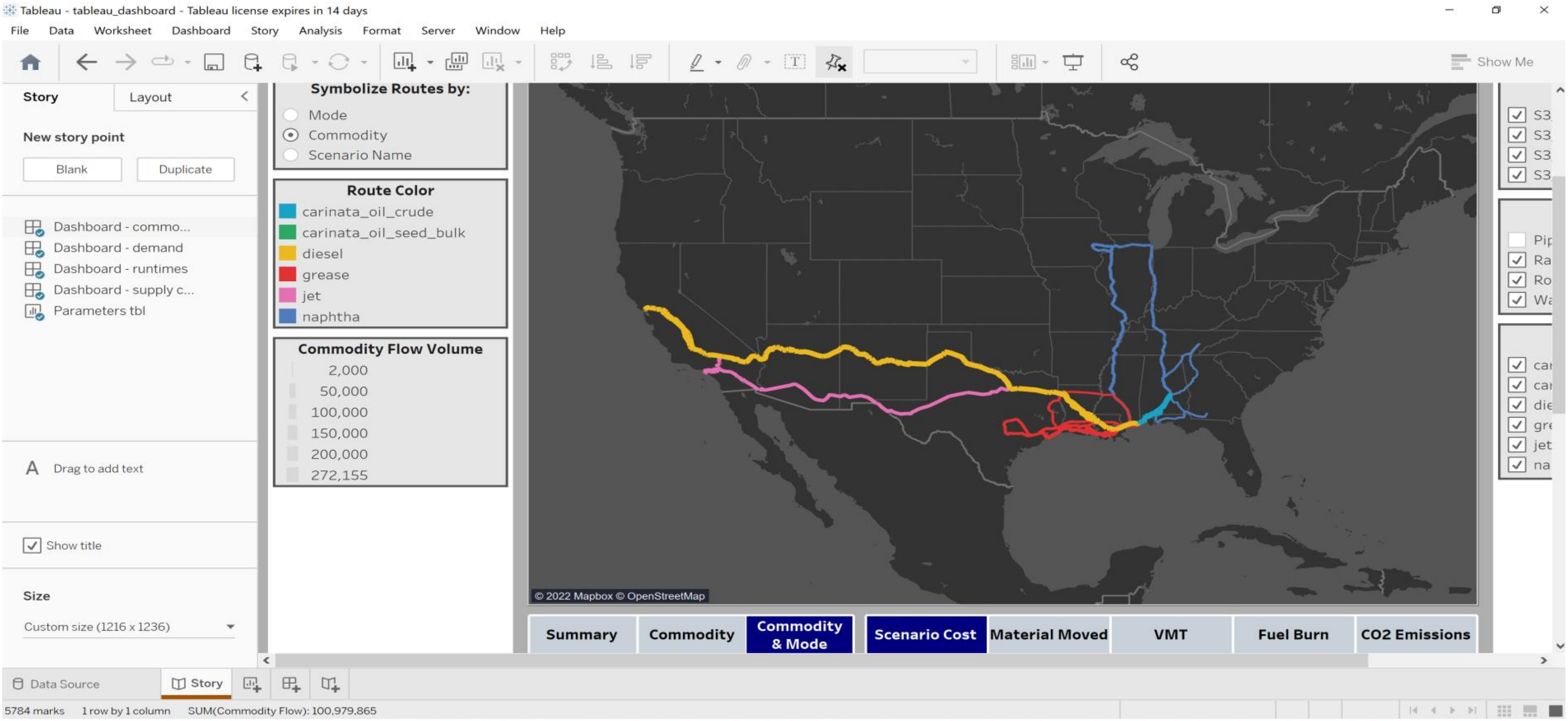
# Tableau Integration with FTOT



# Tableau Integration with FTOT

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