

2025 CAAFI Training on the
Freight and Fuel Transportation Optimization Tool (FTOT)

Participant Worksheet

A. Disruption Scenario Demo

Quick Start #1 demonstrates a simple supply chain with only two facilities and no intermediate processing. In this scenario, a raw material producer in western Massachusetts sends 100 U.S. tons of blueberries to an ultimate destination near Boston. Exhibit 1 presents the optimal routing solution, which is exclusively by road. Exhibit 2 highlights select output metrics.

Exhibit 1. Quick Start #1 optimal routing solution

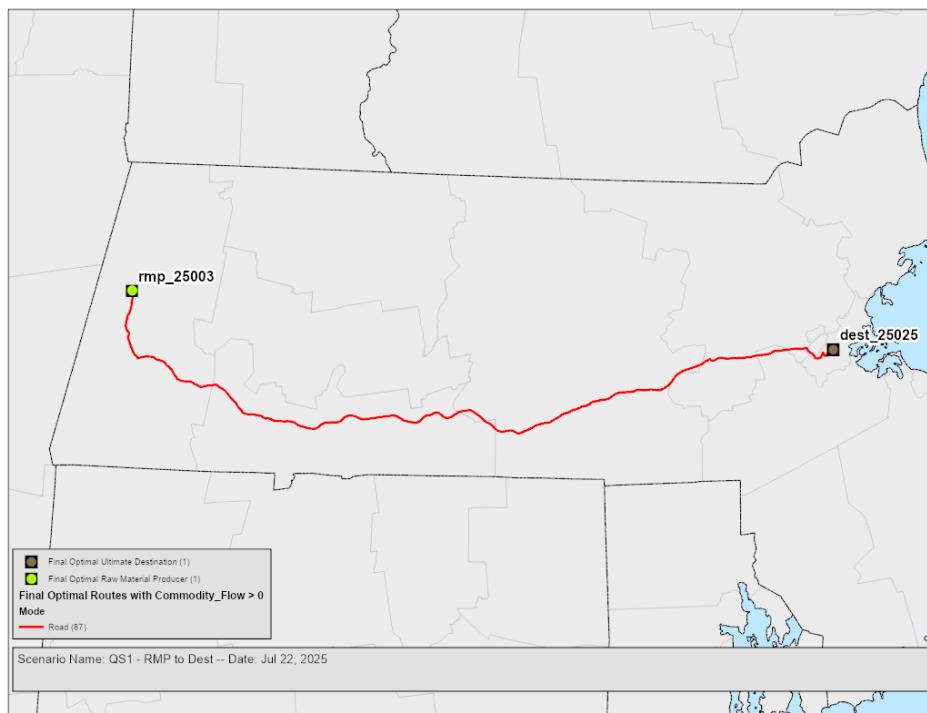


Exhibit 2. Quick Start #1 key output metrics

Metric	Value	Units
Transport Cost	\$2,568	USD
Total Flow	100	U.S. Tons
Network Used	134.8	Miles
Vehicle Distance Traveled	518.4	Vehicle-Miles
CO ₂ Emissions	717,558	Grams

Suppose you want to understand more about the above supply chain's **resilience** in the face of disruption. How do the optimal routing solution and scenario outcomes above change if part of the road network is no longer available?

For example, there have been reports of major flooding in central Massachusetts which you worry could disrupt freight transportation along Interstate 90, the major corridor connecting the western and eastern parts of the state. You decide to create a new FTOT scenario to understand the network resilience implications of a disruption in the region.

I. Set Up a New Scenario

First, create a new scenario starting from Quick Start #1 above.

1. Create a copy of the qs1_rmp_dest scenario folder. Rename the folder "qs1_disruption".
2. Open the new qs1_disruption folder. Delete all files and folders in qs1_disruption **EXCEPT FOR** input_data, run_v8.bat, and scenario.xml. These three files/folders are required inputs for the new scenario.
3. Open the .bat file in a text editor by right-clicking and selecting "Edit in Notepad" or "Edit with Notepad++". Update the XMLSCENARIO environment variable to point to the scenario XML file in the qs1_disruption folder. Save and close.
4. Open the scenario XML file in a text editor:
 - a. Find the <Scenario_Name> element. Change the scenario name to "QS1 - Disruption".
 - b. Find the <Scenario_Description> element. Update the description to indicate that this scenario is a variation on Quick Start #1 with parts of the road network removed.
 - c. Find the <RMP_Commodity_Data> and <Destinations_Commodity_Data> elements. Update these file paths to point to the copied over files in your new scenario directory.
 - d. Find the <Disruption_Data> element. Currently this element is set to "None" because we have not yet provided a disruption CSV file. Leave this element as is for now. We will return and update it later.
 - e. Scroll through the remainder of the XML file to see what other FTOT parameters are configurable. Find the sections of the XML where you can (i) change the default units used in FTOT's reporting, and (ii) change which modes—road, rail, water, crude pipeline, or product pipeline—are permitted in the scenario. We won't change these elements for this scenario, but it is good to know where they are located!
5. Save and close the scenario XML file.

II. Create a Disruption CSV Input File

Next, create a disruption CSV input file to specify which parts of the transportation network are no longer available for use in the new scenario. A disruption CSV allows the user to run an FTOT scenario that excludes specific links from consideration in the optimal routing solution without requiring the user to manually delete those links from the underlying network GIS dataset. This capability enables users to run multiple link removal scenarios without needing to create multiple GIS networks.

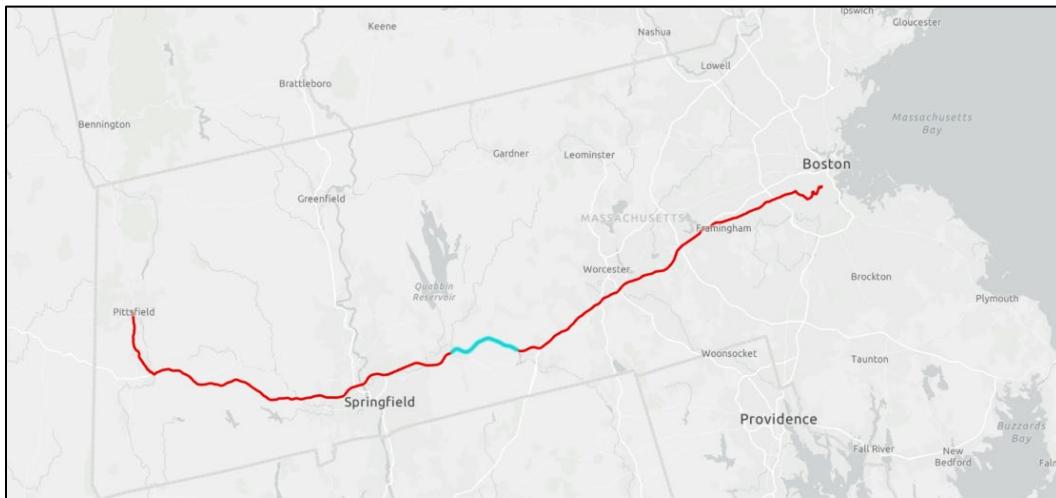
In this exercise, you will disrupt a section of I-90 running through central Massachusetts. Exhibit 3 highlights the specific segment from the Quick Start #1 optimal route that will no longer be available for use via the disruption CSV.

1. Open a new Excel workbook.
2. Type the following **lowercase** headers in the top row of the first three columns of the worksheet: *mode*, *unique_link_id*, *link_availability*.
3. Each link that you want to remove from the network is specified in its own row in the disruption CSV. You are removing only one link, so add the following information to row 2:
 - a. In the *mode* column, type “road” (all lowercase).
 - b. In the *unique_link_id* column, type “165510”. This number corresponds to the link identifier (source_OID field) in the road network’s attribute table in the network GIS dataset.
 - c. In the *link_availability* column, type “0”. This indicates that the link is fully removed.
Note: Partial link availability between 0 (fully disrupted) and 1 (not disrupted) is not currently supported in FTOT.
4. Save the file as “disruption.csv” in the input_data folder in the qs1_disruption directory. Make sure to save it as a standard CSV file and not a CSV UTF-8 file, as this can cause file encoding errors. *Note: Any filename would be fine as long as the disruption CSV file path specified in the scenario XML matches (see next step).*
5. Open the scenario XML file in the qs1_disruption directory again and find the <Disruption_Data> element. Replace “None” in this element with the full/absolute file path to the disruption.csv file you just created:

C:\FTOT\scenarios\quick_start\qs1_disruption\input_data\disruption.csv

6. Save and close the scenario XML.

Exhibit 3. Quick Start #1 optimal route, with the link targeted for disruption highlighted



III. Run the Scenario

You are now ready to run your new scenario:

1. From the qs1_disruption directory, either double-click the .bat file **OR** open a new Command Prompt window, drag and drop the .bat file to the Command Prompt, click into the Command Prompt window, and hit enter.
2. FTOT will begin to run the scenario. New files and folders will populate the qs1_disruption directory. The scenario takes 5-10 minutes to run. When the scenario has finished running, qs1_disruption should have subfolders called Maps and Reports.

Note: If the Command Prompt window prints an error OR closes down and you do not see the “Reports” and “Maps” folders, something went wrong during the scenario run. Try to decode the error messages and address the problem based on the print-out. If the Command Prompt window disappeared before you were able to read the error, the FTOT log files contain the same information. Open the “logs” folder in the “qs1_disruption” directory, open the last modified .log file in a text editor, and scroll to the bottom of the file to see the error messages. When you have made the necessary changes, rerun the scenario.

B. Breakout Session: SAF Scenarios

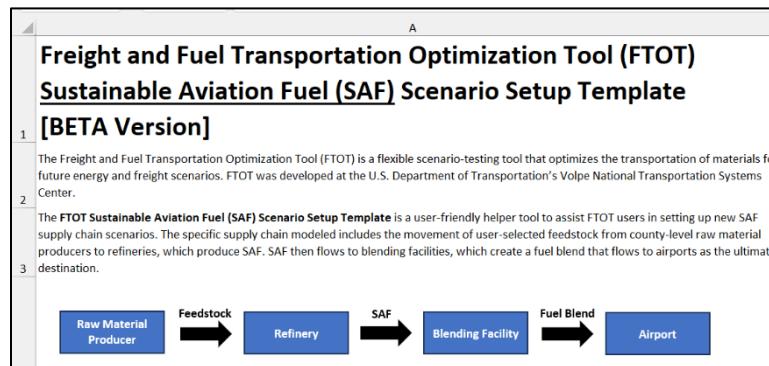
In breakout groups, you will have a chance to test out the beta version of FTOT's SAF Scenario Setup Template. The SAF Scenario Setup Template is an Excel workbook to facilitate the creation of a simple SAF supply chain using existing U.S. data sources.

As a group, select a volunteer to share their screen. Complete the steps below together. Try to finish Part I. If you have time, and if FTOT is installed on your computer, proceed to Parts II and III. An FTOT team member will be available in your breakout room to answer questions.

I. Fill Out the SAF Scenario Setup Template

1. Download FTOT_SAF_scenario_setup_template.xlsx from the training chat pod, and save to a preferred location on your computer. Open the saved file.
2. Skim through the “Instructions” tab. The “Instructions” tab illustrates the SAF supply chain structure followed by the template, lists steps to complete the template, and documents data sources.

Exhibit 4. “Instructions” tab



3. Proceed to the “SAF Filters” tab and follow the worksheet instructions to step-by-step define a supply chain. Complete the steps in order and pay attention to any warnings that may appear beneath the filter menus.
 - a. Select from the FEEDSTOCK locations and types, and provide other requested information.
 - b. Select from the REFINERY and technoeconomic options. FTOT will propose locations for new refineries, but you can also opt to include existing refineries.

Note: Available options, e.g., for processing technology, will update based on the feedstock type selected in the previous step.

 - c. Select BLENDING facility locations, and enter a SAF blend ratio.

Tip: Select no more than 40 potential blending facility locations to manage scenario runtime.

- Select specific AIRPORTS as destinations for blended fuel.

Exhibit 5. "SAF Filters" tab

STEP 1. Use filters and text boxes to provide FEEDSTOCK information.																			
Note: Filters (c) and (d) are impacted by filters in Step 2. Clear filters in both Step 1 and Step 2 to reset.																			
a) Select market scenario* <input type="button" value="Single select"/>				b) Select states <input type="button" value="Ctrl + click to multiselect"/>				c) Select commodity <input type="button" value="Single select"/>				d) Select specific resources <input type="button" value="Ctrl + click to multiselect"/>				e) Enter usable share of feedstock <input type="button" value="Share of available feedstock to be used for SAF. Enter a decimal value between 0 and 1, inclusive."/> <input type="text" value="0.50"/>			
Billion Ton Scenario <input type="button" value="Emerging"/> Mature-market high Mature-market low Mature-market medium Near-term				State <input type="button" value="Alabama"/> Arizona Arkansas California Colorado Connecticut Delaware District of Columbia Florida Georgia Idaho Illinois				Commodity <input type="button" value="Ag processing waste"/> <input type="button" value="Agricultural residues"/> Ethanol Fire reduction thinnings FOG Forest processing waste Intermediate oilseeds Logging residues Other forest waste Other solid waste Paper Plastic				Resource <input type="button" value="Barley straw"/> Corn stover Cotton field residues Oats straw Pruning residues, citrus Pruning residues, noncitrus Pruning residues, tree nuts Rice straw Sorghum stubble Wheat straw							
<i>*See Table ES-1 in the 2023 Billion-Ton Report for scenario definitions: DOE BETO 2023 Billion-Ton Report</i>																			
STEP 2. Use filters and text boxes to provide REFINERY information																			
Note: Filters (a) and (b) are impacted by feedstock selections above. Clear filters in both Step 1 and Step 2 to reset.																			
a) Select processing technology <input type="button" value="Single select"/>				b) Select plant type <input type="button" value="Single select"/>				c) Include existing SAF refineries? <input type="button" value="If Y, a list of current and planned refineries will be queried."/>				d) If Y, select states to query for existing refineries <input type="button" value="Ctrl + click to multiselect. Selections will be ignored if step (c) is 'N'"/>							

Next: Move to Step 2.
↓

- Proceed to the “Configuration” tab. Update the scenario name and scenario description. The other elements on this tab are filled with default values (which you can update if desired) OR come pre-set for SAF scenarios specifically.

Exhibit 6. "SAF Filters" tab

Instructions					
1) Under Basic Information, provide the required information in all cells with grey fill. When available, use the drop-down menus to select a value.					
2) Review the fields in the Additional Settings section. The cells with grey fill are populated with default values but can be changed by the user. Modify these values as needed for your scenario, using the drop-down menus when provided.					
Basic Information					
Scenario Settings Scenario Name: <input type="text"/> Scenario Description: <input type="text"/>		Provide text: <input type="text"/> <input type="text"/>			
<small>Note: If copying data over from a different file, make sure you ONLY paste values to avoid overwriting data validation functionality.</small>					
Default Units					
Commodity Amounts (Solids): <input type="text" value="tons"/>		Select from drop-down menu: <input type="text" value="ton"/>			
Commodity Amounts (Liquids): <input type="text" value="thousand gallons"/>		<input type="text" value="thousand gallons"/>			
Distance: <input type="text" value="miles"/>		<input type="text" value="miles"/>			
Currency: <input type="text" value="usd"/>		<input type="text" value="usd"/>			
File Paths					
Enter full file paths or "None": RMP GIS Feature Layer: <input type="text" value="None"/>		<small>Leave as None for SAF scenario template</small>			
Processor GIS Feature Layer: <input type="text" value="None"/>		<small>Leave as None for SAF scenario template</small>			
Destination GIS Feature Layer: <input type="text" value="None"/>		<small>Leave as None for SAF scenario template</small>			
Permitted Modes					
Set TRUE or FALSE: Road: <input type="text" value="TRUE"/>		<input type="text" value="TRUE"/>			

5. The supply chain input data based on your selections will auto-populate on the “Commodities and Processes” and “Facilities and Amounts” tabs. Review these tabs for informational purposes. Do NOT edit these tabs. If you need to make changes, return to the “SAF Filters” tab.

Note: Raw material producers (feedstock supply locations) will NOT be listed on the “Facilities and Amounts” tab because feedstock quantities will be queried and added to your scenario files during the conversion process in Part II below.

6. Save and close the file.

II. Run the Scenario Setup Tool

Follow the steps below to launch FTOT Tools and convert your filled-out template into a set of scenario files for FTOT.

1. From the main “C:\FTOT” directory, double-click “run_ftot_tools.bat” **OR** open a new Command Prompt window, drag and drop run_ftot_tools.bat file to the Command Prompt, click into the Command Prompt window, and hit enter.
2. Once the FTOT Tools menu loads, enter “8” to launch the Scenario Setup Conversion Tool.
3. Follow the prompts in the command window to point the tool to the filled-out template file and to create a new scenario folder with the converted files. Drag and drop as needed.
4. When the tool finishes running, confirm a new scenario folder has been created and that it contains an input_data folder, a scenario.xml file, and a run_v8.bat file.

Exhibit 7. FTOT Tools

The screenshot shows a Windows Command Prompt window with the title bar 'C:\WINDOWS\system32\cmd.'. Inside the window, there is a large graphic of the word 'FTOT' composed of small squares. Below the graphic, the text 'Version Number: 2025.2, (7/21/2025)' is displayed. A list of numbered options follows:

- [1] xml_tool
- [2] bat_tool
- [3] generate_template_csv_files
- [4] replace_xml_text
- [5] scenario_compare_tool
- [6] network_disruption_tool
- [7] network_validation_tool
- [8] scenario_setup_conversion_tool
- [9] udp_sensitivity_tool
- [10] help
- [11] exit

At the bottom of the window, the text 'Enter a number below to activate a tool' is followed by '>>'.

III. Run the FTOT Scenario

You should be able to run the new FTOT SAF scenario files without further modification, but review the generated input files and manually make any changes needed first. Run your FTOT SAF scenario as you would run any other scenario:

1. From your new SAF scenario folder, double-click “run_v8.bat” **OR** open a new Command Prompt window, drag and drop the .bat file to the Command Prompt, click into the Command Prompt window, and hit enter.
2. The scenario will run in a Command Prompt window. This may take several hours depending on the size of your scenario.