

Freight and Fuel Transportation Optimization Tool Quick Start Tutorial

FTOT 2025.3 Public Release Version

September 30, 2025

DOT-VNTSC-FAA-22-08 Rev. 13

DOT/FAA/AEE/2022-03 Rev. 13

Prepared for:

Federal Aviation Administration
Office of Environment and Energy
Washington, DC



U.S. Department of Transportation
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REPORT DOCUMENTATION PAGE			<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 30, 2025		3. REPORT TYPE AND DATES COVERED Document, 7/2022-9/2025
4. TITLE AND SUBTITLE Freight and Fuel Transportation Optimization Tool Quick Start Tutorial and Scenario Checklist: FTOT 2025.3 Public Release Version			5a. FUNDING NUMBERS FC14C222 FC14C323 FC14CA24	
6. AUTHOR(S) Olivia Gillham, Kirby Ledvina, Kristin C. Lewis (PM), Mark Mockett, Matthew N. Pearlson, Peter Wilke, Jaewoong Yun, Kevin Zhang			5b. CONTRACT NUMBER 693KA9-22-T-00008 693KA9-23-T-00005 693KA9-24-T-00002	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Volpe National Transportation Systems Center, 220 Binney Street, Cambridge, MA 02142			8. PERFORMING ORGANIZATION REPORT NUMBER DOT-VNTSC-FAA-22-08 Rev. 13	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Federal Aviation Administration, 800 Independence Ave, SW, Washington, DC 20591			10. SPONSORING/MONITORING AGENCY REPORT NUMBER DOT/FAA/AEE/2022-03 Rev. 13	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Volpe created the Freight and Fuel Transportation Optimization Tool (FTOT) to support the FAA, DOE, and the U.S. Navy's Office of Naval Research to assess optimal transport options for freight and fuel supply chains. FTOT is a flexible scenario-testing tool that optimizes the transportation of materials for future energy and freight scenarios. FTOT models and tracks commodity-specific information and can take into account conversion of raw materials to products (e.g., crude oil to jet fuel/diesel) and fulfillment of downstream demand. This report documents the Quick Start Scenarios developed to help the user explore the functionality of the FTOT public release 2025.3. This documentation is updated quarterly and available on the Public FTOT GitHub repository: https://github.com/VolpeUSDOT/FTOT-Public				
14. SUBJECT TERMS Freight, fuel, geospatial information systems, GIS, network analysis, transportation optimization.			15. NUMBER OF PAGES 13	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18

298-102

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Installation Guide

To complete installation of FTOT, refer to Section 2 of the FTOT User Guide. A demonstration video for how to install FTOT is also available on the Volpe Center YouTube channel here: <https://youtu.be/VXay2v5KguA>. FTOT should be installed before running the Quick Start scenarios below.

Quick Start Tutorial

Overview

Assuming you have installed FTOT, this is the place to learn how to run FTOT scenarios and view the results. After downloading the Quick Start scenarios, the directory and file path containing the Quick Start files should look like this:

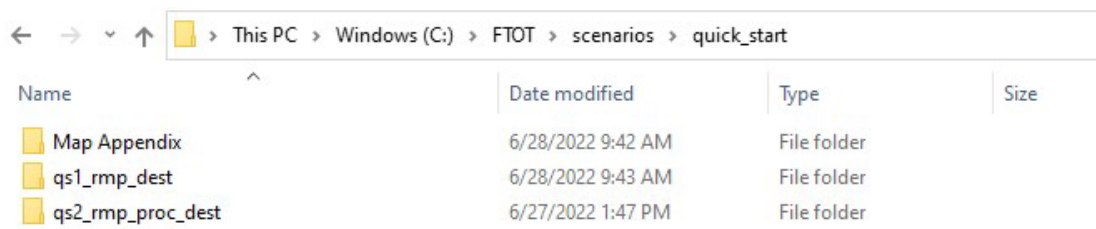


Figure 1: FTOT Quick Start Folder Structure

The Quick Start series is a set of simple scenarios designed to introduce supply chain modeling in FTOT. The first scenario (Quick Start 1) is the simplest; the second scenario (Quick Start 2) adds more complexity with intermediate processing and mode choice restrictions. In addition to demonstrating the FTOT functionality, the Quick Start scenarios can also serve as a template for creating user-specified scenarios.

Getting Started

- FTOT scenarios are stored in the C:\FTOT\scenarios\quick_start folder. Within this directory, each scenario includes its own dedicated subfolder for storing the scenario configuration and outputs.
- Each scenario (e.g., qs1_rmp_dest) contains a batch script file called **run_vX.bat**, where the X denotes the version number of the latest XML schema.
- You can run the batch script by double clicking it or manually executing it in the Command Prompt. NOTE: If you have stored your FTOT installation anywhere other than “C:\FTOT” or your FTOT Python environment anywhere other than “C:\FTOT\python3_env” (these are the defaults as defined in the FTOT installation instructions), then you will need to modify these paths for each batch script that you run to appropriately reflect the actual paths on your machine.

Results

- Informational logging is available in the command shell during the run. Detailed logging is available in the **.\logs** folder.

- The user is encouraged to read the logs to familiarize themselves with the FTOT operations occurring during each step.
- FTOT generates results in the **.\Reports** and **.\Maps** folders of the scenario.
- The report is found in a timestamped **reports** folder within the **.\Reports** directory of the scenario. The FTOT report shows a summary of the results for each step in the analysis. The report is broken into the following sections: run time summary of each step, intermediate calculations and optimal results, configurations, warnings, and errors.
- A Tableau Dashboard (**tableau_dashboard.twbx**) can also be found in the timestamped **reports** folder within the **.\Reports** directory of the scenario. This can be opened in Tableau Reader.
- The map files can be found in a timestamped folder within the **.\Maps** directory of the scenario. FTOT generates a series of maps for each FTOT step to help the user see what happens during the scenario.
- Maps generated by the Quick Start scenarios can be found in the C:\FTOT\scenarios\quick_start\Map Appendix folder. The user can compare the map files generated from their own scenario runs against these to confirm the scenarios ran correctly.

For more information on interpreting results, see the complete FTOT Documentation, specifically the User Guide.

More Information

The Quick Start documentation details the nuances of each run and provides brief overviews of the main results. **It is highly recommended that the user run both Quick Start scenarios after installation, as they will confirm that FTOT has been installed correctly and is producing the correct outputs.** A demonstration video on how to run Quick Start 1 can be found on the Volpe Center YouTube channel here: https://youtu.be/P_8oRHxuSc.

Troubleshooting

See the troubleshooting guide in the FTOT User Guide for tips on how to resolve common issues like runtime dependency errors (missing software), missing input data, and missing base maps.

Quick Start 1 (QS1) – Simple Supply Chain with No Intermediate Processing (RMP to Destination)

Instructions: to run the QS1 scenario, execute run_v8.bat in quick_start\qs1_rmp_dest. The run should take about 5-10 minutes. A description of this scenario is below, including the expected results.

Purpose

Quick Start 1 is the simplest supply chain model. The purpose of this scenario is to demonstrate the movement of one commodity from a single origin (known as a raw material producer, or RMP) to a single destination.

Input Data

FTOT requires two sets of input data to model the supply chain: (i) geospatial facility location data and (ii) facility-commodity data. Quick Start 1 sends 100 tons of blueberries from facility rmp_25003 in western Massachusetts to facility dest_25025 near Boston, with no intermediate processors.

Running a Scenario

The scenario XML configuration file (e.g., scenario.xml) is used to define file locations and parameter values used in the QS1 run. The QS1 scenario file defines the scenario name and description and points to the base transportation network, as well as geospatial input data and facility-commodity data.

Execute the batch script (run_v8.bat) to initiate the FTOT run and execute the sequence of FTOT steps described in the User Guide.

Viewing Results

FTOT generates four main outputs from a scenario: a text report, a CSV-formatted report that can be analyzed using Excel or Tableau, a packaged Tableau workbook, and a sequence of maps showing each of the steps in the FTOT run.

The text report, CSV-formatted report, and the Tableau dashboard (tableau_dashboard.twbx) can be found in a timestamped reports folder in the .\Reports directory of the scenario.

Optimal routing results are shown in the By Commodity & Mode story point of the Tableau dashboard, as well as the map outputs. The map files can be found in a timestamped folder in the .\Maps directory of the scenario.

To check that the QS1 results are accurate, the user can compare their output maps to those in the Map Appendix folder within the quick_start directory. Figure 2 shows the optimal routing solution. The optimal solution shows that the material travels over the road network from the RMP to the destination. In this case, the Massachusetts Turnpike (Interstate 90) is used for the majority of the trip.

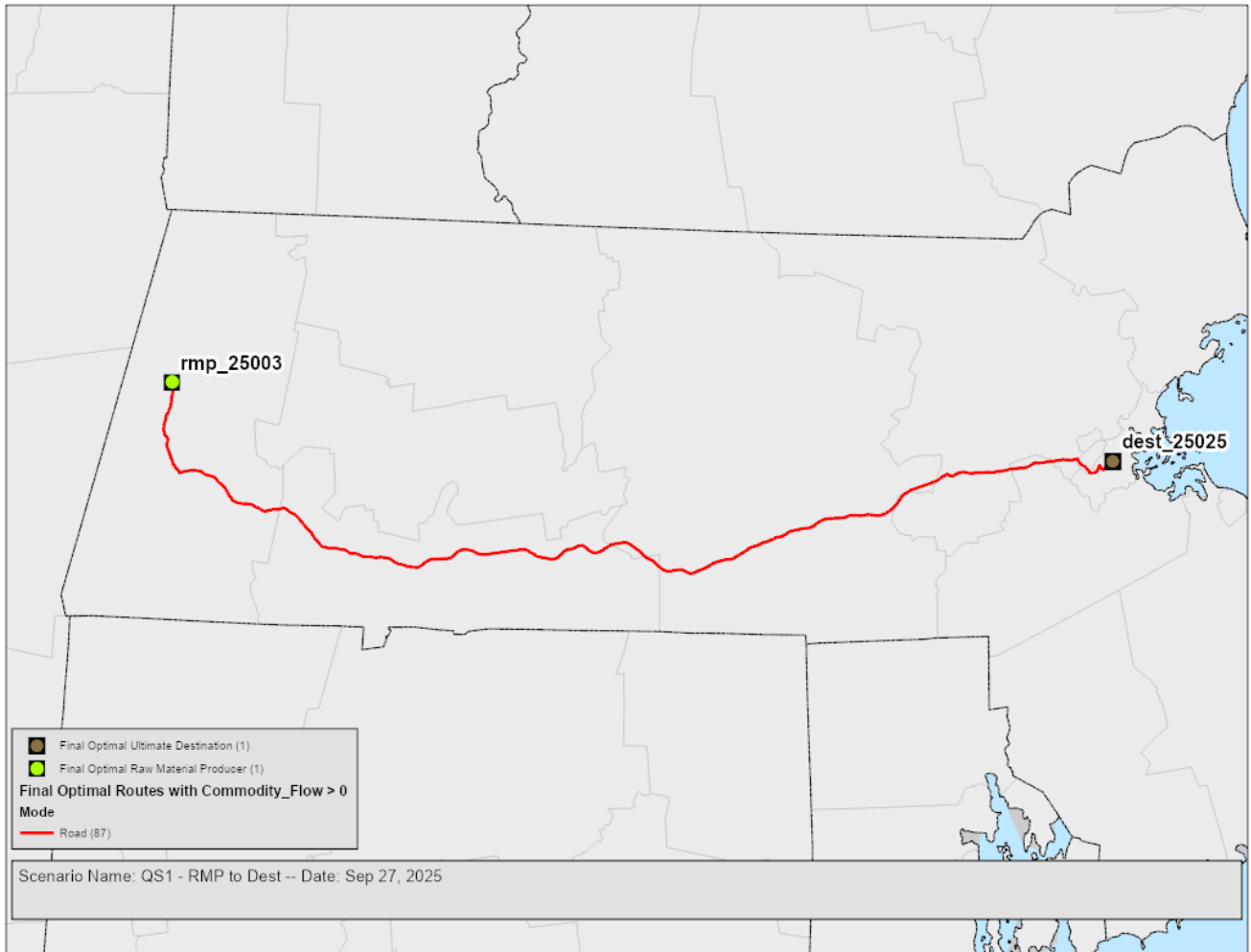


Figure 2: QS1 Optimal Solution

Quick Start 2 (QS2) – Supply Chain with Intermediate Processing Facility (RMP to Processor to Destination, No Road)

Instructions: to run the QS2 scenario, execute run_v8.bat in quick_start\qs2_rmp_proc_dest. The run should take about 5-10 minutes. A description of this scenario is below, including the expected results.

Purpose

Quick Start 2 increases the complexity of the supply chain by including an intermediate processing facility. The purpose of this scenario is to demonstrate the movement of one commodity from a single RMP to an intermediate processor facility where the commodity is converted to a new material, and then from the processor to a single destination. In this case, the RMP supplies blueberries and the destination demands jam. An intermediate processor will take blueberries as an input and convert it to jam using the facility-commodity input data specified by the user.

This scenario also demonstrates the functionality to exclude elements of the multimodal network (e.g., allow flows on a subset of modes). In this case, commodities are not permitted to route via the road network. Further commodity-mode specifications are detailed in the User Guide and Reference Scenarios.

Input Data

The input geospatial and facility-commodity data are similar to Quick Start 1. The data are set up to send 100 tons of blueberries from facility rmp_25003 in western Massachusetts to processor facility proc_25015 further east, where blueberries are converted to jam at a 1:1 ratio, which is sent to destination dest_25025 near Boston. The processor feature class of the facilities geodatabase and a new facility-commodity input file proc.csv are used to specify the location and characteristics of the processor used.

Figure 3 shows the processor facility-commodity CSV file. All rows of the CSV file correspond to the processor facility proc_25015, as shown in the “facility_name” field. The first two rows specify the input commodity (blueberries) and output commodity (jam) with the defined conversion ratio of 100 tons of blueberries in for 100 tons of jam out (e.g., at a 1:1 ratio). The third row, with commodity specified as “total”, is used to define processor capacity at the facility level (not the commodity level) and defines a maximum input capacity of 100 tons, as specified with the “max_capacity” field. Since no minimum processor input is defined (e.g., specified with a “min_capacity” field), it is set to zero tons by default.

	A	B	C	D	E	F	G	H
1	facility_name	facility_type	commodity	value	units	phase_of_matter	io	max_capacity
2	proc_25015	processor	blueberries	100	tons	solid	i	
3	proc_25015	processor	jam	100	tons	solid	o	
4	proc_25015	processor	total		tons	solid	i	100

Figure 3: Quick Start 2 processor file (proc.csv).

To exclude the road network mode, the Route_Optimization_Script section of the scenario XML file has been edited to set Road as a permitted mode to False. FTOT will exclude the road network from the optimization and look for alternative flows on other permitted modes (e.g., rail, water).

Running a Scenario

The QS2 scenario configuration file is similar to the QS1 scenario configuration file, with the following changes:

- Scenario Name and Scenario Description are changed to note processors are included.
- The base processor GIS layer and processor commodity data input CSV file are now specified (Base_Processors_Layer and Processors_Commodity_Data, respectively). Previously, these fields were labeled “None.”
- The Road field is set to False under the Permitted_Modes section of the Route_Optimization_Script settings.

Execute the batch script (run_v8.bat) to initiate the FTOT run and execute the sequence of FTOT steps described in the User Guide.

Viewing Results

Optimal routing results are shown in the By Commodity & Mode story point of the Tableau dashboard, as well as the map outputs. To check that the QS2 results are accurate, the user can compare their output maps to those in the Map Appendix folder within the quick_start directory. Figure 4 shows the optimal routing solution. The optimal solution shows that the material travels over the rail network from the RMP to processor, and then from the processor to the destination. Note the route change compared to QS1. In this case, FTOT used the rail network for the entirety of the route since flows over the road network were not permitted.

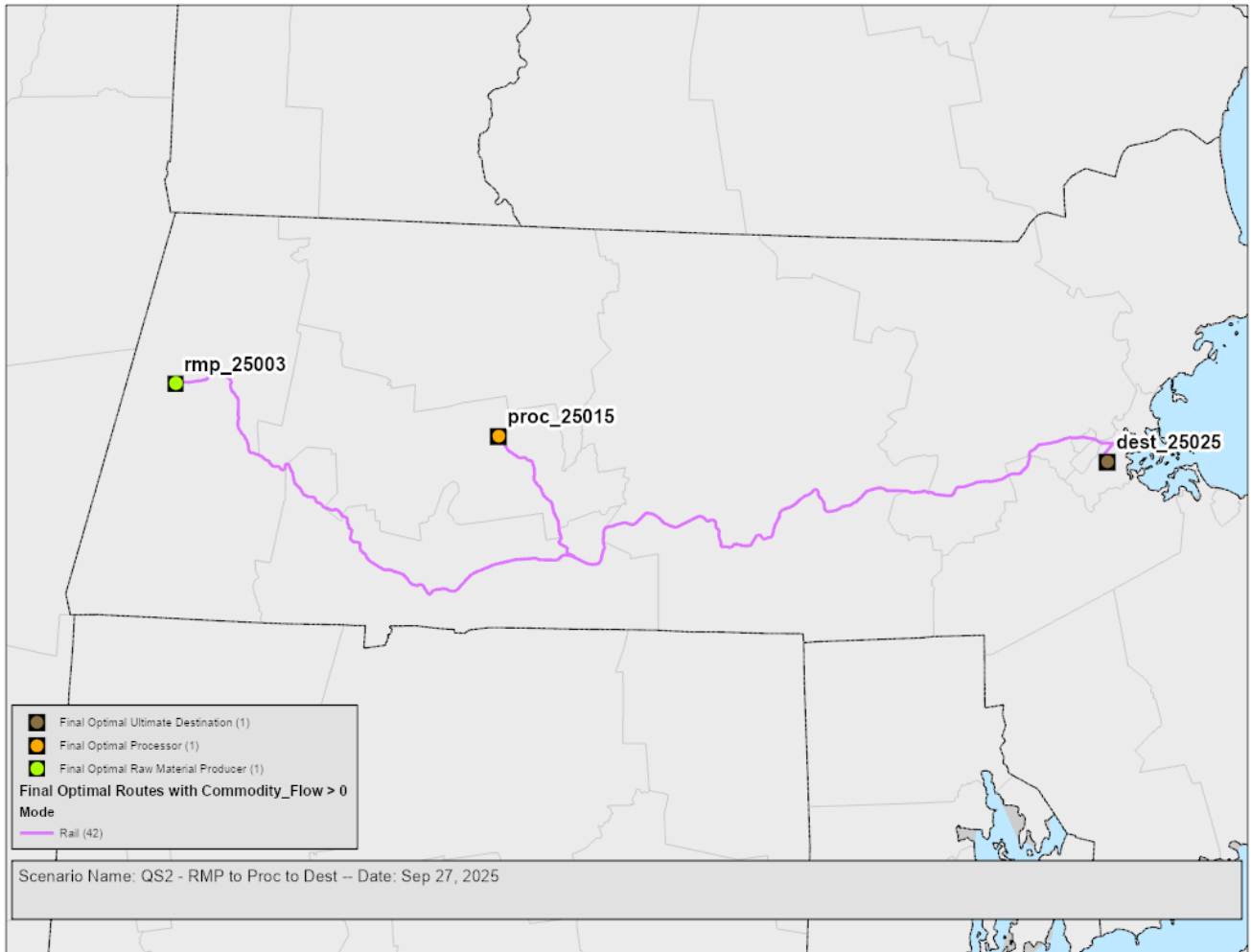


Figure 4: QS2 Optimal Solution

Scenario Run Checklist

After the user has run the Quick Start scenarios and familiarized themselves with FTOT's basic functionalities, they can begin to create their own FTOT scenarios. Refer to Section 3 of the FTOT User Guide for more detailed information. A demonstration video on how to create your own custom FTOT scenario can be found on the Volpe Center YouTube channel here: https://youtu.be/JmDtU_cKI1g. The FTOT Reference Scenarios Documentation provides concrete examples of several FTOT features, including candidate generation, disruption scenarios, and commodity-mode specifications, and should be used as a guide and template for setting up FTOT scenarios.

Acknowledgements

This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through FAA contract 693KA9-24-T-00002 under the supervision of Prem Lobo. Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA.