

FTOT Minimum Data Requirements

For International Scenarios

U.S. DOT Volpe Center

This document describes the **MINIMUM DATA REQUIREMENTS** for scenarios run with the Freight and Fuel Transportation Optimization Tool (FTOT). For each checklist item, this document also lists an example of the data requirement as provided in FTOT's downloadable [scenario dataset](#). After gathering the items below, please see the [FTOT User Guide](#) for the network schema and additional details on preparing the data.

- **Road, rail, water, and/or pipeline network(s)** for scenario mode(s) of interest as GIS-based linear feature classes that meet the following requirements:
 - Feature classes for each network mode use a meters-based coordinate system and are stored together in a common Esri file geodatabase.
 - Features within each mode are fully connected and routable (e.g., grade separated, no gaps between features).
 - **Road, rail, and water networks** must include an attribute for link length (e.g., in kilometers).
 - **Pipelines** must be categorized as a crude or product pipeline and have attributes for (i) the cost to transport one barrel between the network link's origin and destination and (ii) the direction of commodity flow.
 - For multimodal movements to be modeled, intermodal facilities (see below) must be directly connected to the networks associated with each relevant mode through a segment (artificial link) in the mode's feature class.
 - Example: See `common_data/networks/FTOT_Public_US_Contiguous_Network_v2024.gdb`

For improved analysis, road, rail, and water networks can optionally include attributes for link type (e.g., functional class, highly recommended), direction (one- or two-way indicator, highly recommended), urban or rural designation (road only), limited or nonlimited access designation (road only), link capacity, and observed vehicle volume. In addition, weightings (e.g., impedances, highly recommended) based on link type can be separately input into FTOT to encourage or discourage flows on certain types of segments.

- **Intermodal facilities and transloading costs (if multiple modes included)** that meet the following requirements:
 - Intermodal facilities should be a GIS-based point feature class in the same Esri file geodatabase with attributes specifying which modal networks each facility connects to.
 - Transloading costs are separately entered per unit of commodity (e.g., in currency units per metric ton for solids).
 - FTOT includes default U.S. transloading costs, but regional values may provide more accurate results.
 - Example (facilities): See "intermodal" feature class in above network GDB

- **Facility locations** as distinct GIS point feature classes for (i) raw material producers, (ii) processors, if applicable, and (iii) ultimate destinations.
 - Example: See *common_data/facilities/counties.gdb*

If processing locations (e.g., biorefineries) are not yet established, FTOT can generate candidate locations based on optimization of transportation costs and supply chain constraints.

- **Facility-commodity information**, specifically the following:
 - For each **raw material producer**: the output commodity and available quantity.
 - For each **user-provided processor** (if desired): the input and output commodities and conversion ratios.
 - For FTOT-generated **candidate processors** (if desired):
 - The input and output commodities and conversion ratios.
 - Minimum and maximum capacity in terms of total input commodity.
 - Facility capital cost as a cost per unit of input commodity (e.g., in currency units per metric ton of capacity).
 - For each **ultimate destination**: the commodity and total quantity demanded.
 - Example: See *CSV files in quick_start/qs2_rmp_proc_dest/input_data*

Optional fields for user-provided processors include maximum capacity (recommended, per commodity or facility), minimum quantity to operate, and build cost for facilities not yet in existence.

- **Transport costs by mode (highly recommended)**, considering the following:
 - **Road, rail, and water** transport costs can be specified by mode and commodity phase (liquid or solid). Costs should be per unit of distance and commodity flowed (e.g., in currency units per metric ton-mile).
 - **Pipeline** transport costs should be per barrel for each pipeline origin-destination pair and should be included as a network attribute.
 - FTOT includes default U.S. transport costs, but regional values may provide more accuracy.
 - Example: See *"Modal_Costs" section in quick_start/qs1_rmp_dest/scenario.xml*

- **Emissions factors by mode (highly recommended)**, considering the following:
 - **For road**, carbon dioxide (CO₂) emissions factors should be in grams of CO₂ per unit of distance (e.g., grams per mile).
 - **For rail, water, and pipeline**, CO₂ emissions factors should be in grams of CO₂ per unit of distance and commodity flowed (e.g., grams per metric ton-mile).
 - FTOT includes default U.S. emissions factors, but regional values may provide more accuracy.
 - Example: See *"Assumptions" section in quick_start/qs1_rmp_dest/scenario.xml*

For enhanced emissions reporting, users can optionally provide non-CO₂ emissions factors, emissions factors by detailed road type (urban/rural, limited/nonlimited access), specifications for commodity-specific vehicle types, and/or densities of liquid commodities.