FTOT 2023.3

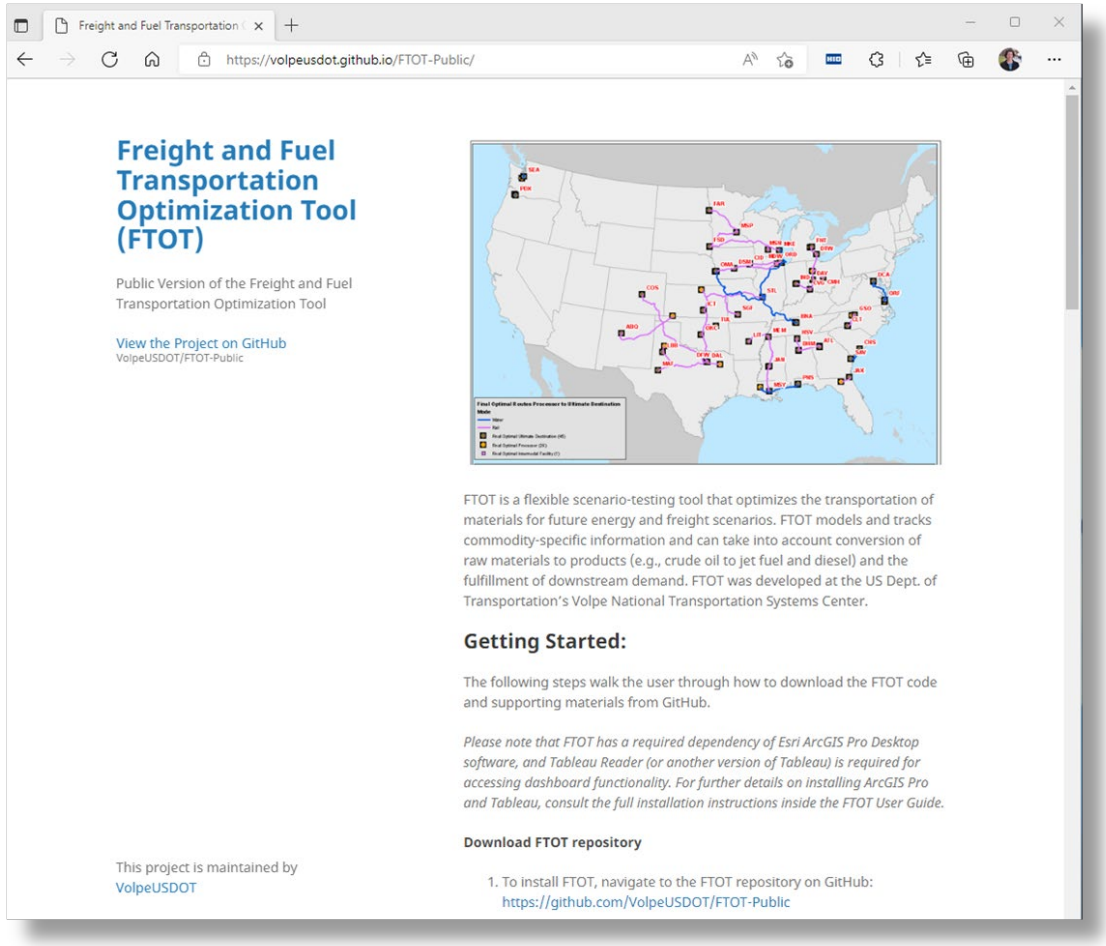
Users Group Meeting

November 2, 2023

FTOT Landing Page

volpeusdot.github.io/FTOT-Public

- FTOT is an open-source tool available on GitHub.
- Includes full documentation and “Quick Start” scenarios, default datasets, video tutorials.
- Updated versions released quarterly.
- Issues/bugs/requests can be raised on GitHub site.
- We welcome feedback and suggestions, additional projects, collaborations.

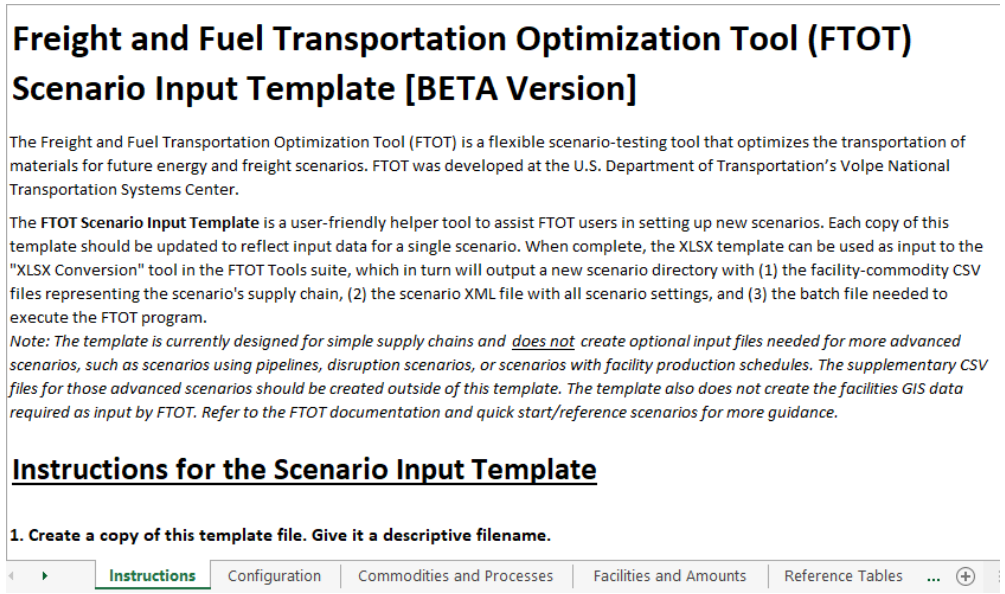


Agenda

- XLSX template and FTOT Tool for input file creation
- Incorporation of CO_2 emissions-related costs in optimization
  - User-defined input parameters
  - Additional cost definitions within FTOT
  - Updated reporting
- North American multimodal network
- Other updates
  - FTOT-SCR aligned with FTOT version 2023.2
  - Emissions calculations by vehicle load
  - Bug fixes
- [Time permitting] XLSX template demo

User Support: XLSX template and conversion tool

- Goal: Help users get their scenario data into FTOT input files
- Two components
  - Excel-based input data template
  - Complementary FTOT Tool to convert XLSX workbook into corresponding FTOT input files
- Creates a batch file, a scenario XML, and all facility-commodity CSV files*
- Example XLSX workbooks have been included with the FTOT codebase



Freight and Fuel Transportation Optimization Tool (FTOT) Scenario Input Template [BETA Version]

The Freight and Fuel Transportation Optimization Tool (FTOT) is a flexible scenario-testing tool that optimizes the transportation of materials for future energy and freight scenarios. FTOT was developed at the U.S. Department of Transportation's Volpe National Transportation Systems Center.

The **FTOT Scenario Input Template** is a user-friendly helper tool to assist FTOT users in setting up new scenarios. Each copy of this template should be updated to reflect input data for a single scenario. When complete, the XLSX template can be used as input to the "XLSX Conversion" tool in the FTOT Tools suite, which in turn will output a new scenario directory with (1) the facility-commodity CSV files representing the scenario's supply chain, (2) the scenario XML file with all scenario settings, and (3) the batch file needed to execute the FTOT program.

Note: The template is currently designed for simple supply chains and does not create optional input files needed for more advanced scenarios, such as scenarios using pipelines, disruption scenarios, or scenarios with facility production schedules. The supplementary CSV files for those advanced scenarios should be created outside of this template. The template also does not create the facilities GIS data required as input by FTOT. Refer to the FTOT documentation and quick start/reference scenarios for more guidance.

Instructions for the Scenario Input Template

1. Create a copy of this template file. Give it a descriptive filename.

Instructions | Configuration | Commodities and Processes | Facilities and Amounts | Reference Tables ...

*Currently does not create required GIS inputs or optional CSV files

New Functionality: Emissions-based optimization

- Incorporation of CO_2 emissions-related costs in optimization
- Involves updates to
  - Input parameters in scenario XML
  - Cost definitions within FTOT
  - Reporting metrics
- This is an optional feature – FTOT defaults to standard transport cost-based optimization in absence of related XML elements
- New Reference Scenario (renumbered RS8) demonstrating functionality

New Functionality: Emissions-based optimization (2)

- User-defined input parameters in scenario XML
  - Transport_CO2_Scalar
    - Share of impeded transport cost to use in the optimization
    - Accepts decimal from 0.0 to 1.0 (defaults to 1.0)
  - CO2_Cost_Scalar
    - Share of carbon cost to use in the optimization
    - Accepts decimal from 0.0 to 1.0 (defaults to 0.0)
  - CO2_Unit_Cost
    - String for cost per unit of CO_2 emissions
    - Defaults to '191 USD/ton'
- XML elements are optional and excluded from all QS and RS templates except for the new RS8 on CO_2-based optimization

New Functionality: Emissions-based optimization (3)

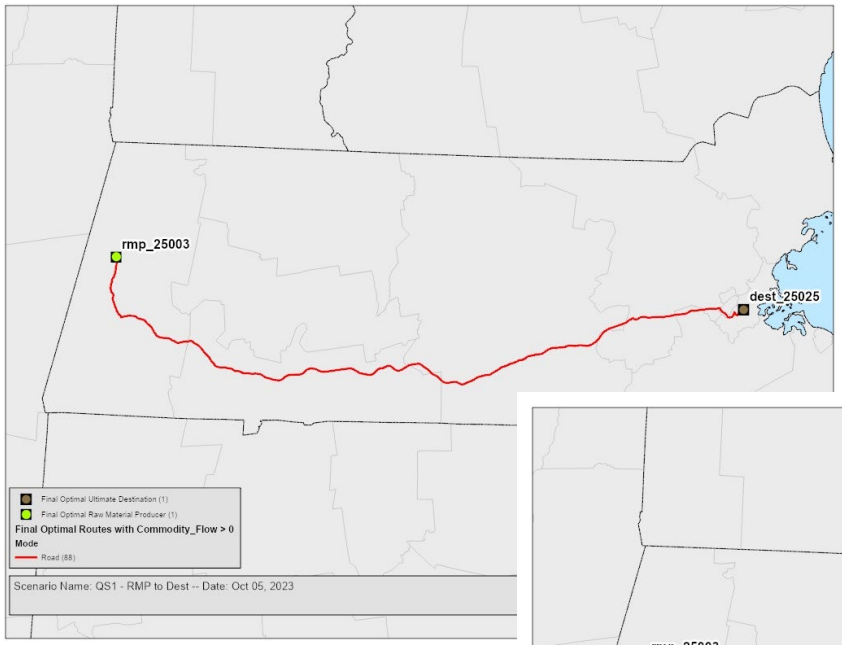
- *CO_2 cost* is included in *routing cost* when CO2_Cost_Scalar is non-zero
  - *Routing cost* is used to select optimal routes and facilities
  - Previously, *routing cost* only included ***impeded*** *transport cost*
- Added two new reporting lines for CO_2 scenarios:
  - Fraction of routing cost from transport
  - CO_2 cost

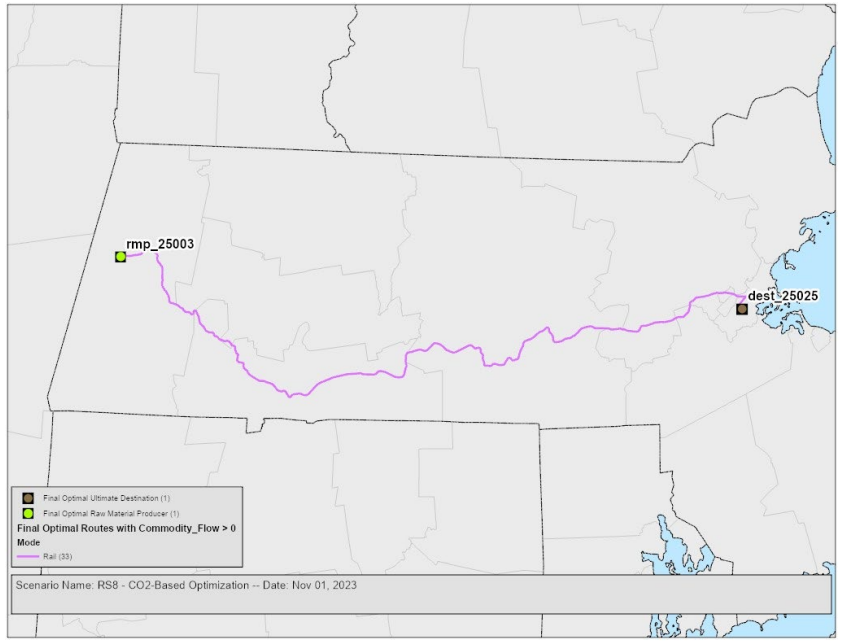
Routing Cost Formula

$$C_{xabyab} = \sum_{(u,v,m)} (S_t t_{m,p} l_{u,v} i_{m,d} + S_c e_m l_{u,v} D)$$

- Transport cost scalar S_t
- Modal transport cost $t_{m,p}$ for the commodity's phase *p*
- Link length $l_{u,v}$
- Link type impedance $i_{m,d}$ for link type *d*
- CO_2 cost scalar S_c
- Modal emissions factor e_m
- CO_2 unit cost *D*
- Origin node *u*, destination node *v*
- Mode *m* that creates a continuous path from *u* to *v*
- Origin facility *x*, destination facility *y*
- Commodity *a*, time period *b*

New Functionality: Emissions-based optimization (4)





Above: QS1 routed with only transport cost

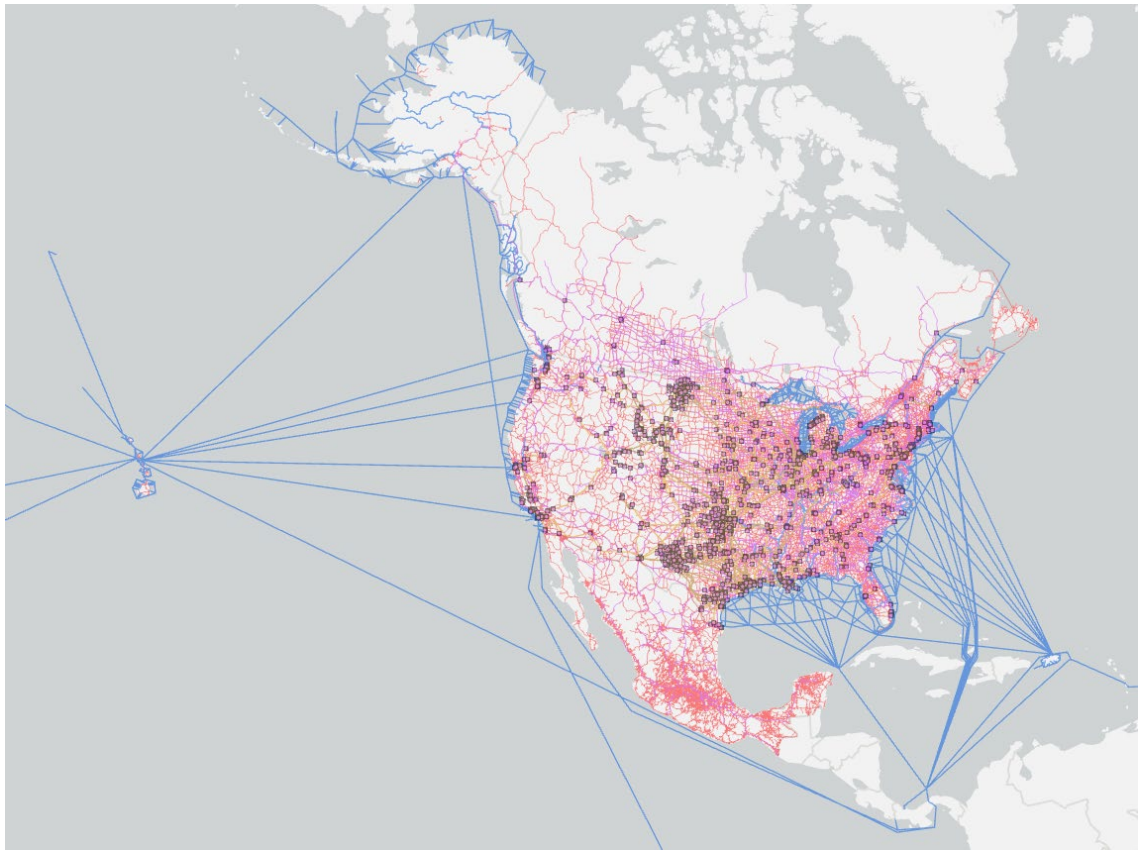
Right: QS1 routed with only CO_2 cost

Mode	Link Type	Transport Cost ($)	Impeded Transport Cost ($)	CO_2 Cost ($)
Road	Interstate	2200.00	2200.00	117.48
Road	Freeways & arterials	2200.00	2420.00	117.48
Road	Minor arterials	2200.00	2640.00	117.48
Road	Collectors & local roads	2200.00	2860.00	117.48
Rail	Class 1 owned STRACNET	470.00	470.00	44.85
Rail	Other STRACNET	470.00	517.00	44.85
Rail	Class 1 owned non-STRACNET	470.00	564.00	44.85
Rail	Class 1 rights non-STRACNET	470.00	611.00	44.85
Rail	All other rail	470.00	658.00	44.85
Water	High volume	320	320.00	79.80
Water	Medium volume	320	416.00	79.80
Water	Low volume	320	512.00	79.80

Comparison of transport, impeded transport, and CO_2 costs across FTOT modes and link types, assuming 100 miles transporting 100 tons of solid commodity

New Resource: North American Multimodal Network

- Draft North American multimodal network integrates available Canadian, Mexican and Alaska/Hawaii network data
- Network includes road, rail, waterway, and intermodal facility data for Canada, along with rail and road data for Mexico
- Facilitates North American scenarios with a scope beyond the continental United States
- Available upon request from the FTOT Team
- More details are available in Appendix B of the Technical Documentation
- Continental United States scenarios should continue to use the default FTOT network (better road data, smaller file size)



Other Updates

- Aligned FTOT-SCR with FTOT version 2023.2, bringing in new FTOT base functionality from the last four releases.
- Made the impedance weights CSV file optional. Weights default to 1.0 if the CSV is not found.
- Updated methodology and reporting for full vs. partial vehicle loads
  - Decimal vehicle loads used for calculation of…
    1. Number of vehicles, vehicle-distance traveled, road CO2, and fuel burn metrics
    2. Non-road CO2 on artificial links
  - However, nearest full truckload used for non-CO2 emissions on road
- *Coming Soon: Tutorial video on updating custom network for use in FTOT*

Other Updates

Bug fixes:

- Link impedances. Corrected a bug in how impedances were assigned to unrecognized link types. If an impedance weights CSV file is provided but a link type in the modal feature class is not recognized, FTOT now correctly applies the maximum weight listed for that mode.
- Detailed emissions reporting. Corrected a bug in how detailed emissions factors were assigned to road types missing values for either the *limited_access* or *urban* attributes.
- Network density reduction (NDR). Corrected a bug related to use of NDR for scenarios involving multiple processes, a subset of which are candidate generation processes.
- Tableau dashboard. Corrected a bug in the Tableau workbook summary graphs for transport cost, network used, vehicle-distance traveled, fuel burn, and CO2 and made other minor fixes and improvements.

Demo: XLSX template and conversion tool