MTA TrainTime Avoided Carbon Calculator Technical Appendix

Background

The TrainTime Avoided Carbon Calculator feature estimates the life-cycle greenhouse gas (GHG) emissions avoided from travel on Metro-North Railroad or Long Island Rail Road (LIRR) compared to an equivalent trip between the same origin and destination in a single-occupancy average car.

Avoided emissions are the amount of greenhouse gases, primarily measured in carbon dioxide equivalents (CO_2e), that are not released into the atmosphere as a result of implementing sustainable practices or technologies, in this case opting for transit. Avoided carbon is distinctly different from sequestered/absorbed carbon, which refers to removing carbon from the atmosphere and storing it.

Approach

Life-cycle emissions, or well-to-wheel emissions, include the combined direct emissions from transportation fuel combustion in vehicle engines and the upstream emissions from extraction, production, and transportation of those fuels.

The TrainTime app presents the difference in absolute life-cycle emissions between a rail trip and car trip from the ticket origin to destination. To formulate this, the highway distance and rail distance between the origin and destination locations are measured, converted to emissions using 2022 distance-based emission factors, and the difference between them is calculated. This value is then multiplied by the trip type and quantity of tickets purchased.

This comprehensive avoided carbon calculation is represented by the following equation:

$$\textit{Avoided carbon} = [(d_V \times EF_V) - (d_R \times EF_R)] \times \textit{trip type} \times \textit{ticket quantity}$$

avoided carbon (lb CO_2e) = life-cycle GHG emissions avoided through trip
d_V (mi) = vehicle driving distance between trip origin and destination
EF_V (lb CO_2e/mi) = vehicle emissions factor based on share of vehicle type in MTA counties
d_R (mi) = rail distance between trip origin and destination
EF_R (lb CO_2e/mi) = rail emissions factor based on proportion of trip in Metro-North and LIRR territory
trip type = one-way (1) or round-trip (2)
ticket quantity = number of tickets purchased

Avoided emissions for tickets are calculated, summed, and expressed as pounds of CO_2e as well as select equivalencies. Assumptions made and the sources used for the distance activity data and distance-based life-cycle emissions factors are described in the following sections.

Assumptions

- Vehicle trips are assumed to be single occupancy even if multiple tickets are purchased (i.e., passengers would have driven from origin to destination individually).

- Only the portion of the trip from the origin to destination train stations was considered. Net avoided carbon may be smaller or larger if the boundary is expanded to cover the door-to-door trip.
- Proportion of vehicle emissions factor attributable to electric vehicles was calculated using the life-cycle electricity factor for the New York City Westchester eGrid subregion, assuming that vehicles would charge in this subregion.

Inputs/Activity Data

Data	Description	Source
Driving distance	Vehicle driving distance between ticket origin and destination.	Google Maps
Rail distance	Rail distance between ticket origin and destination along fixed guideway Metro-North or LIRR route.	MTA internal data
Vehicle emission factor	Average life-cycle emissions per vehicle mile traveled for single-occupancy light-duty vehicle based on registered light-duty vehicle fuel types (gasoline, diesel, electric) in NYS counties in the MTA's service area. Per-mile emission factors for gasoline, diesel, and electric vehicles derived from fuel economy and volume-based emission factors.	Fossil fuels: US DOT BTS and NYC 2019 Greenhouse Gas Inventory; CRIS 2022 Default Emission Factors; Argonne National Laboratory GREET Fleet Footprint Calculator Electricity: EPA Green Vehicle Guide; eGrid 2022; eGrid 2022 fuel mix with 2022 NYS Statewide GHG Emissions Report; GREET 2023; NREL/TP-510-32575; NYSERDA Report 22-18
Metro-North rail emission factor LIRR rail emission factor	Average life-cycle emissions per passenger mile for Metro-North service. Average life-cycle emissions per passenger mile for LIRR service.	Fossil fuels: CRIS 2022 Default Emission Factors; 2022 NYS Statewide GHG Emissions Report Electricity: eGrid 2022; eGrid 2022 fuel mix with 2022 NYS Statewide GHG Emissions Report; GREET 2023; NREL/TP-510-32575; NYSERDA Report 22-18 Intensity metric: 2022 Annual Passenger Miles Traveled from National Transit Database
100-year global warming potential	Factors used to convert amounts of CH_4 and N_2O greenhouse gases into their equivalent amount of carbon dioxide (CO_2e).	IPCC Fifth Assessment Report (AR5)