TransDASH

*Value Over Volume*

# Emissions Analysis Report

# FY 2024

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# Executive Summary

This analysis estimates the annual amount of $CO_2$, $N_2O$, and $CH_4$ emissions avoided by transferring private auto trips to public transit trips and $CO_2$, $N_2O$, and $CH_4$ emissions produced by operating service vehicles and agency facilities. $N_2O$ and $CH_4$ emissions are converted to $CO_2e$, or $CO_2$ equivalent, and combined with $CO_2$ emissions to create a singular figure, $CO_2e$. In FY 2024, LTD is estimated to have a net effect of removing 18,377.34 metric tons of $CO_2e$ from the LTD service area.

# Methodology and Sources

This emissions analysis utilizes agency-provided inputs and publicly available information sources to estimate the agency's annual $CO_2$ (Carbon Dioxide), $N_2O$ (Nitrous Oxide), and $CH_4$ (Methane) emissions. The $CO_2$, $N_2O$, and $CH_4$ emission estimates are reported in MT, or metric tons. For simplicity, $N_2O$ and $CH_4$ are converted to $CO_2e$, or $CO_2$ equivalent, and combined with $CO_2$, allowing this analysis to report out a single $CO_2e$ figure.

## This methodology was created by reviewing the following sources:

- American Public Transportation Association (APTA) (2018). *Quantifying Greenhouse Gas Emissions from Transit*. APTA Standards Development Program Recommended Practice, APTA SUDS CC-RP-001-09, Rev. 1. https://www.apta.com/research-technical-resources/standards/sustainability/apta-suds-cc-rp-001-09/.
- The Climate Registry (TCR) (2019). *General Reporting Protocol Version 3.0*. https://theclimateregistry.org/download/general-reporting-protocol-v3-05-2019/.
- National Academies of Sciences, Engineering, and Medicine. 2015. *Quantifying Transit's Impact on GHG Emissions and Energy Use—The Land Use Component*. Washington, DC: The National Academies Press. https://doi.org/10.17226/22203.
- National Academies of Sciences, Engineering, and Medicine. 2021. *An Update on Public Transportation's Impacts on Greenhouse Gas Emissions*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26103.

## This analysis is composed of four key steps:

1. Estimating the MT of $CO_2e$ emissions avoided by transferring private auto trips to public transit trips.
2. Estimating the MT of $CO_2e$ emissions avoided due to public transit's land-use effect.
3. Estimating the MT of $CO_2e$ emissions produced by the public transit agency through vehicle operations.
4. Estimating the MT of $CO_2e$ emissions produced by the public transit agency through facility operations.

## Estimating the MT of $CO_2e$ emissions avoided by transferring private auto trips to public transit trips

This process is composed of the following steps:

1. Quantify the annual agency passenger miles traveled (PMT).
    a. Assumption is made that one passenger mile of public transit = one passenger mile of private auto.
2. Calculate the mode shift factor.
    a. Mode shift data acquired from: American Public Transportation Association (APTA) (2017). *Who Rides Public Transportation*. https://www.apta.com/research-technical-resources/research-reports/who-rides-public-transportation/.
3. Multiply the PMT by the mode shift factor to calculate the Vehicle Miles Traveled (VMT) Displacement.
4. Determine the private auto average fuel economy. Then, divide the VMT Displacement by the fuel economy to calculate the gallons of gasoline avoided.
    a. Fuel economy data acquired from: U.S. Department of Transportation, Bureau of Transportation Statistics (BTS). (2025). *Average Fuel Efficiency of U.S. Light Duty Vehicles* [Excel spreadsheet]. https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles.
5. Estimate the MT of $CO_2$ emissions that would have been produced if the avoided gallons of gasoline had been used by private auto. Use a $CO_2$ emissions factor and multiply it by the gallons of gasoline to estimate the amount of $CO_2$ emissions avoided.
    a. $CO_2$ emissions factor acquired from:
        i. The Climate Registry (TCR) (2025). *2025 Default Emission Factors*. https://theclimateregistry.org/wp-content/uploads/2025/03/2025-Default-Emission-Factors-03-2025.pdf.
6. Use the estimated $CO_2$ emissions and the $N_2O$ and $CH_4$ global warming potentials (GWP) to estimate the amount of $N_2O$ and $CH_4$ emissions that would have been produced if the gallons of gasoline had been used by private auto. Then, convert the estimated $N_2O$ and $CH_4$ emissions to $CO_2e$ emissions and combine with the $CO_2$ emissions to get the total $CO_2e$ emissions avoided by transferring private auto trips to public transit trips.

a. Global warming potentials (GWP) acquired from: United States Environmental Protection Agency (US EPA). *Understanding Global Warming Potentials*. https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

## Estimating the MT of $CO_2e$ emissions avoided due to public transit's land-use effect

This process is composed of the following steps:

1. Gather the agency UZA Name, UZA Population, and UZA Total Passenger Miles Traveled (PMT). Estimate the UZA Transit Passenger Miles per Capita by dividing the UZA PMT by the UZA Population.

    a. UZA data acquired from:

        i. U.S. Department of Transportation, Federal Transit Administration (FTA) (2023). *2023 Annual Database UZA Sums* [Excel spreadsheet]. The National Transit Database (NTD). https://www.transit.dot.gov/ntd/data-product/2023-annual-database-uza-sums.

2. Estimate the UZA transportation efficiency VMT and UZA Land Use Efficiency VMT using the provided formulas and the UZA transit passenger miles per capita. Then, estimate the transit multiplier by adding the UZA transportation efficiency VMT and the UZA land use efficiency VMT and then dividing this total by the UZA transportation efficiency VMT.

    a. The UZA transportation efficiency VMT formula, the UZA land use efficiency VMT formula, and the transit multiplier formula were acquired from:

        i. National Academies of Sciences, Engineering, and Medicine. 2021. *An Update on Public Transportation's Impacts on Greenhouse Gas Emissions*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26103.

3. Estimate the amount of avoided community VMT by multiplying the previously calculated VMT displacement by the transit multiplier and then subtracting from this total the VMT displacement.

    a. The avoided community VMT formula was acquired from:

i. National Academies of Sciences, Engineering, and Medicine. 2021. *An Update on Public Transportation's Impacts on Greenhouse Gas Emissions*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26103.

4. Estimate the avoided community gallons of gasoline by dividing the avoided community VMT by the previously gathered private auto average fuel economy.

5. Estimate the MT of $CO_2$ emissions that would have been produced if the avoided community gallons of gasoline had been used by private auto. Use the previously acquired $CO_2$ emissions factor and multiple it by the community gallons of gasoline to estimate the amount of $CO_2$ emissions avoided.

6. Use the estimated $CO_2$ emissions and the previously gathered GWPs to estimate the amount of $N_2O$ and $CH_4$ emissions that would have been produced if the avoided community gallons of gasoline had been used by private auto. Then, convert the estimated $N_2O$ and $CH_4$ emissions to $CO_2e$ emissions and combine with the $CO_2$ emissions to get the total $CO_2e$ emissions avoided due to public transit's land-use effect.

## Estimating the MT of $CO_2e$ emissions produced by the public transit agency through vehicle operations

This process is composed of the following steps:

1. Gather from the agency, by mode, all fuel types used, the volume of fuel used, and the vehicle miles traveled (VMT) using each fuel source.

2. To estimate the $CO_2$ emissions, gather the $CO_2$ emissions factor by fuel source, first multiply (by fuel source) the fuel volume and the gathered $CO_2$ emissions factors, and then combine the totals together to get the estimated total amount of $CO_2$ emissions produced by operating public transit vehicles.

    a. $CO_2$ emissions factor acquired from:

        i. The Climate Registry (TCR) (2025). *2025 Default Emission Factors*. https://theclimateregistry.org/wp-content/uploads/2025/03/2025-Default-Emission-Factors-03-2025.pdf.

3. To estimate the $N_2O$ and $CH_4$ emissions, gather the $N_2O$ and $CH_4$ emissions factors by fuel source, multiply (by fuel source) the gathered emissions factors and VMT, and combine the totals together to get the estimated total amount

of $N_2O$ and $CH_4$ emissions produced by operating public transit vehicles. Now, $N_2O$ and $CH_4$ emissions are converted to $CO_2e$ emissions by multiplying them by the previously gathered GWPs

a. $N_2O$ and $CH_4$ emissions factors acquired from:

i. The Climate Registry (TCR) (2025). *2025 Default Emission Factors*. https://theclimateregistry.org/wp-content/uploads/2025/03/2025-Default-Emission-Factors-03-2025.pdf.

## Estimating the MT of $CO_2e$ emissions produced by the public transit agency through facility operations

This process is composed of the following steps:

1. Gather from the agency (by facility, if available) the total annual energy consumption from facilities, which is typically electricity and natural gas.

2. Determine the agency's EPA Region and use this region to determine the electricity emission factors for $CO_2$, $N_2O$, and $CH_4$. Gather the Natural Gas emissions factors for $CO_2$, $N_2O$, and $CH_4$.

   a. $CO_2$, $N_2O$, and $CH_4$ emissions factors acquired from:

   i. The Climate Registry (TCR) (2025). *2025 Default Emission Factors*. https://theclimateregistry.org/wp-content/uploads/2025/03/2025-Default-Emission-Factors-03-2025.pdf.

3. Using the gathered emissions factors, multiply the energy consumption sources by these factors to calculate the $CO_2$, $N_2O$, and $CH_4$ emissions. Then, $N_2O$ and $CH_4$ emissions are converted to $CO_2e$ emissions by multiplying them by the previously gathered GWPs and combining them with the $CO_2$ emissions.

# Agency Data Inputs

The agency data inputs used in this analysis were provided by LTD staff. Below is a table displaying the agency data inputs for FY2024:

## Service Supplied Data

| Mode | UPT | VRM | VRH | PMT |
|---|---|---|---|---|
| **Fixed Route** | 6,313,680 | 2,869,542 | 228,955 | 20,805,598 |
| **Demand Response** | 125,684 | 804,219 | 79,676 | 837,773 |
| **Vanpool** | 12,632 | 146,241 | 2,902 | 605,346 |
| **TOTAL** | **6,451,996** | **3,820,002** | **311,533** | **22,248,717** |

## Vehicle Fuel Use Data

| Mode | Fuel Type | Volume |
|---|---|---|
| **Fixed Route** | Gas (GGE) | 5,281 |
| | Diesel (DGE) | 600,455 |
| | Electric (kWh) | 1,328,921 |
| **Demand Response** | Gas (GGE) | 144,297 |
| **Vanpool** | Gas (GGE) | 5,848 |

Vehicle miles traveled by mode and fuel type were not provided, therefore $N_2O$ and $CH_4$ emissions were only able to be estimated for vehicles using electricity since $N_2O$ and $CH_4$ emissions for electricity are calculated based on volume rather than vehicle miles traveled. $N_2O$ and $CH_4$ emissions have a minimal impact on the overall $CO_2e$ emissions, so overall $CO_2e$ emission estimates are still considered to be accurate.

## Facility Energy Use Data

| Energy Type | Energy Usage |
|---|---|
| Electricity (kWh) | 718,675 |
| Natural Gas (Therms) | 60,770 |

# Analysis Results

In this section, the results of this analysis and an explanation of the results are displayed:

| $CO_2e$ Emissions Avoided | MT |
|---|---|
| Fixed Route | (4,131.53) |
| Demand Response | (166.36) |
| Vanpool | (120.21) |
| Land-Use Effect | (22,385.30) |
| **TOTAL** | **(26,803.40)** |
| $CO_2e$ Emissions from Service Vehicles | MT |
| Fixed Route | 6,566.76 |
| Demand Response | 1,266.93 |
| Vanpool | 51.35 |
| **TOTAL** | **7,885.03** |
| $CO_2e$ Emissions from Facilities | MT |
| Electricity (kWh) | 210.77 |
| Natural Gas (Therms) | 330.26 |
| **TOTAL** | **541.03** |
| Net $CO_2e$ Emissions | MT |
| Service Vehicles | 3,466.92 |
| Facilities | 541.03 |
| Land-Use Effect | (22,385.30) |
| **TOTAL** | **(18,377.34)** |

In FY 2024, LTD is estimated to have avoided a total of 26,803.40 MT of $CO_2e$ emissions. 4,418.11 MT of $CO_2e$ emissions are estimated to have been avoided by transferring private auto trips to public transit trips, and 22,385.30 MT of $CO_2e$ emissions are estimated to have been avoided through the public transit land-use effect, or public transit services reducing the total community vehicle miles traveled. LTD is estimated to have produced 7,885.03 MT of $CO_2e$ emissions by operating service vehicles and 541.03 MT of $CO_2e$ emissions by operating agency facilities. In total, LTD is estimated to have removed 18,377.34 MT of CO2e emissions from the LTD service area.