



Circuit electric GEM vehicle on New Rochelle Earth Day 2024. Image from [Circuit](#).

# An On-Demand Electric Transit Case Study of New Rochelle, New York

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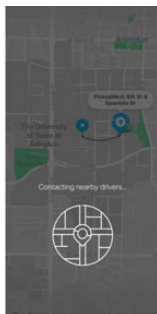
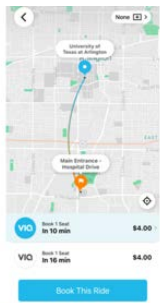
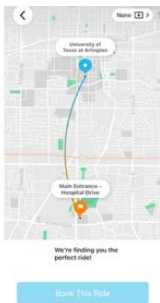
**Bonnie Powell**, Josh Sperling, Johnny Esteban, Emily Serrano, Dustin Weigl, Stan Young

*Transportation Research Board (TRB) Annual Meeting  
January 7, 2025*

# Motivation & Background

- This work is part of an ongoing series of on-demand transit case studies conducted by NREL.
  - **7 case studies of real-world ODT systems** conducted to date (3 with fleets of EVs, 4 with fleets of gas or traditional hybrid vehicles).
  - <https://www.nrel.gov/transportation/sustainable-on-demand-transit.html>
- **On-demand transit (ODT)** refers to a public service that is flexible in both space and time, responsive to user demand.

Recent trends include:



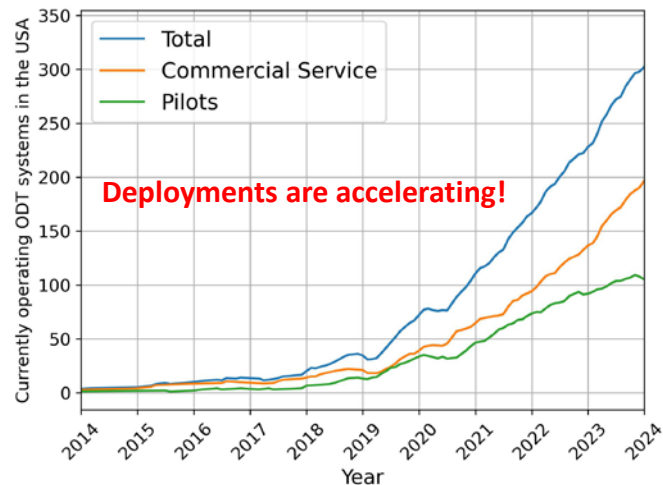
## On-Demand Transit

Screenshots from Arlington's ODT system smartphone app ("Arlington Transportation").



## Electrification of Transit

Photo by Joe DelNero / NREL 86265.



Data from Lukas Foljanty [ODT World Map](#), August 2024.

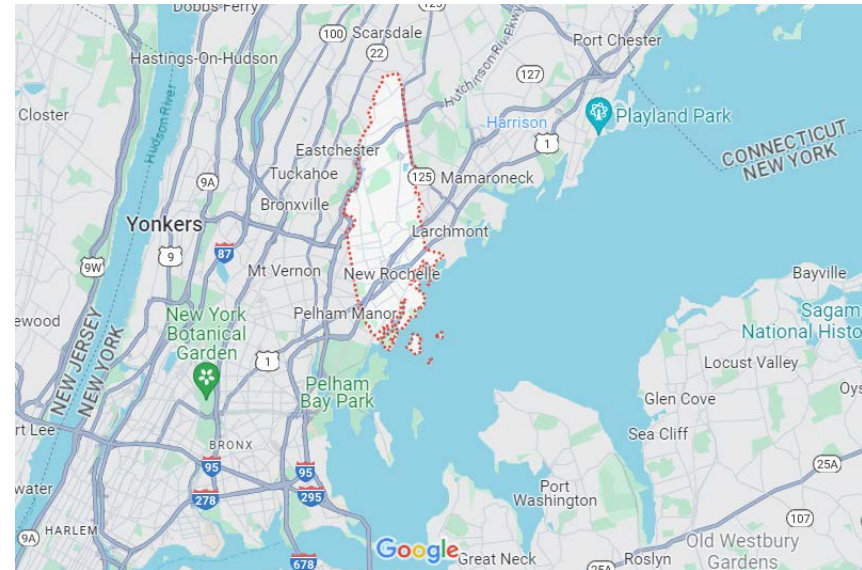


## Right-Sizing of Transit

An ODT vehicle in Fort Erie, Ontario. Photo from the town of Fort Erie.

# New Rochelle Case Study

- Industry-provided data used for a preliminary assessment of an **on-demand transit service using small, low-speed electric vehicles**.
- New Rochelle, New York
  - Southernmost county of mainland New York state.
  - Population of ~80,000 and population density of ~8,000/mi<sup>2</sup>
  - Greater than half of the community population are non-white
  - Median household income ~\$100,000
  - Average of 51% of income in this community is spent on just housing and transport (according to <https://htaindex.cnt.org/map/>)



*Map of New Rochelle, New York outlined in red, near the borders of New Jersey and Connecticut. Image from Google Maps.*

# New Rochelle Case Study

## Research Questions

*Who is using the New Rochelle ODT system, how is it being used, and to what extent does ODT using low-speed EVs provide community and sustainability benefits?*

This study aims to improve ODT services by addressing this question and analyzing:

1. **Sociodemographics** of riders (age, gender, race, number of jobs, disadvantaged communities).
2. **Temporal dynamics** (rider demand by time of day, day of week, and from 2019 to 2023).
3. **Spatiotemporal dynamics** (top pickup and drop-off locations at different times and days).

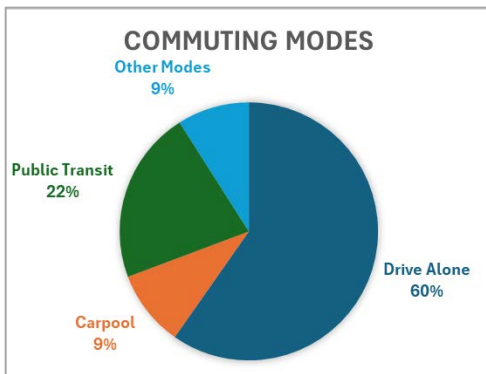


*Circuit electric GEM vehicle and Sedan vehicle wrapped in Empire City Casino advertisement in New Rochelle, 2024. Image from [Circuit](#).*

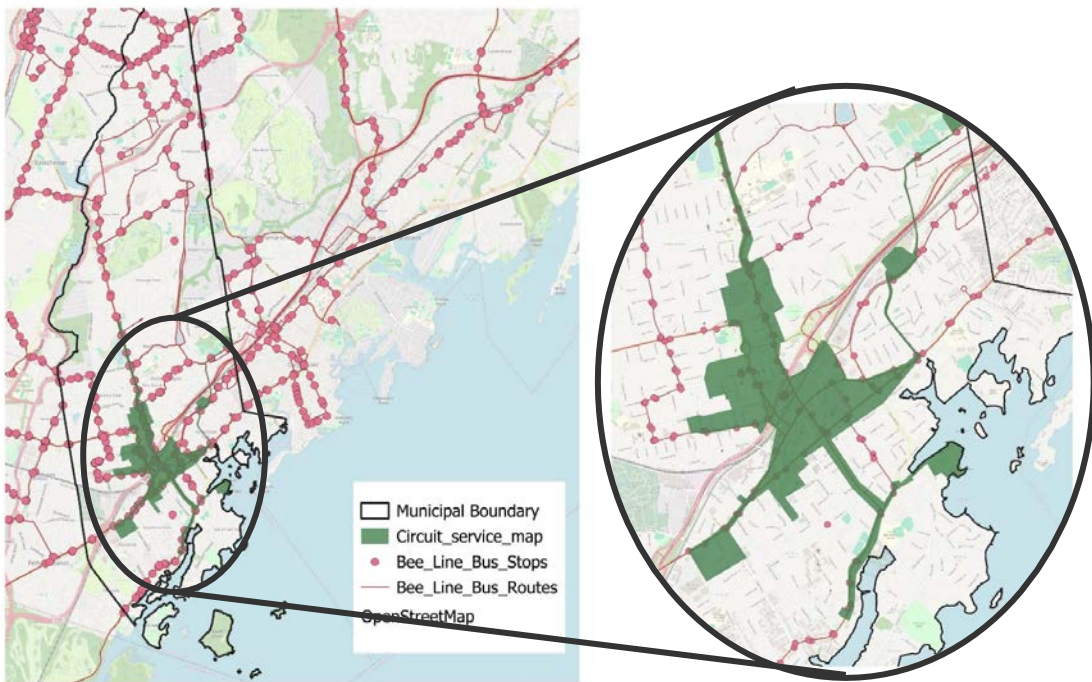


# New Rochelle Transit Options

- Existing transit options
  - Fixed-route bus (Bee-Line Westchester bus).
  - Rail (Amtrak, MTA Metro-North commuter rail).
  - Transportation Network Companies (Uber/Lyft) & taxis.
  - On-demand electric shuttle service.
  - Veo ride electric scooters and bikes.



Data from the American Community Survey 2016 – 2020.



Bee-Line Westchester bus routes and bus stops (red) and on-demand transit service map (green) in New Rochelle. Route and stop locations from [WCDOT](#), map created by NREL.

# New Rochelle ODT Service

- **Fleet**

- Six fully electric GEM e6 vehicles with lithium-ion batteries, four capable of fast charging, each holding up to five passengers.
- The vehicles' mileage ranges between approximately 27 and 78 miles.
- Vehicles use a mix of daytime and nighttime charging at both public and private charging stations.
- In late 2024, 3 GEM vehicles were replaced with sedans.

- **Hours of operation**

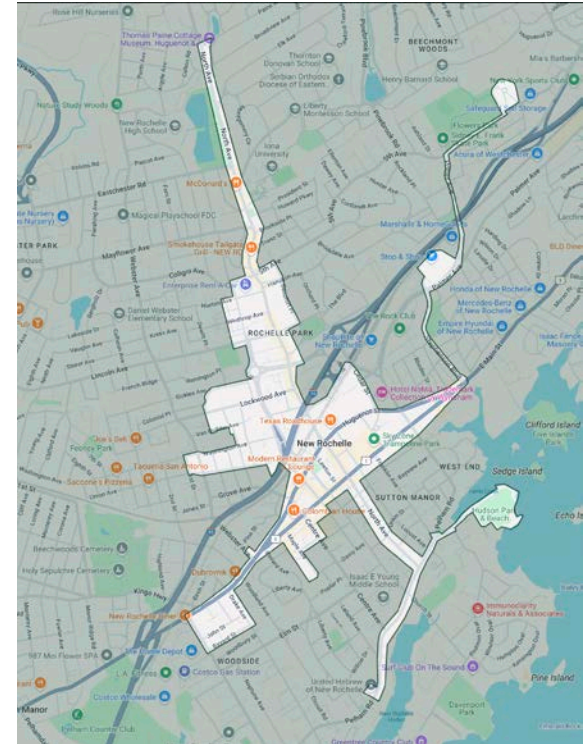
- Monday–Thursday: 7 a.m.– 7 p.m.
- Friday: 7 a.m.– 10 p.m.
- Saturday: 12 p.m.– 10 p.m.
- Sunday: 12 p.m.– 7 p.m.

- **Requesting a ride**

- App or by street-hailing a vehicle, with app request having priority.

- **Shared rides**

- Approximately 40% of rides were shared as of June 2024.



*Circuit coverage area for New Rochelle as of 2025.*

*Image from [Circuit](#).*

# New Rochelle ODT Service

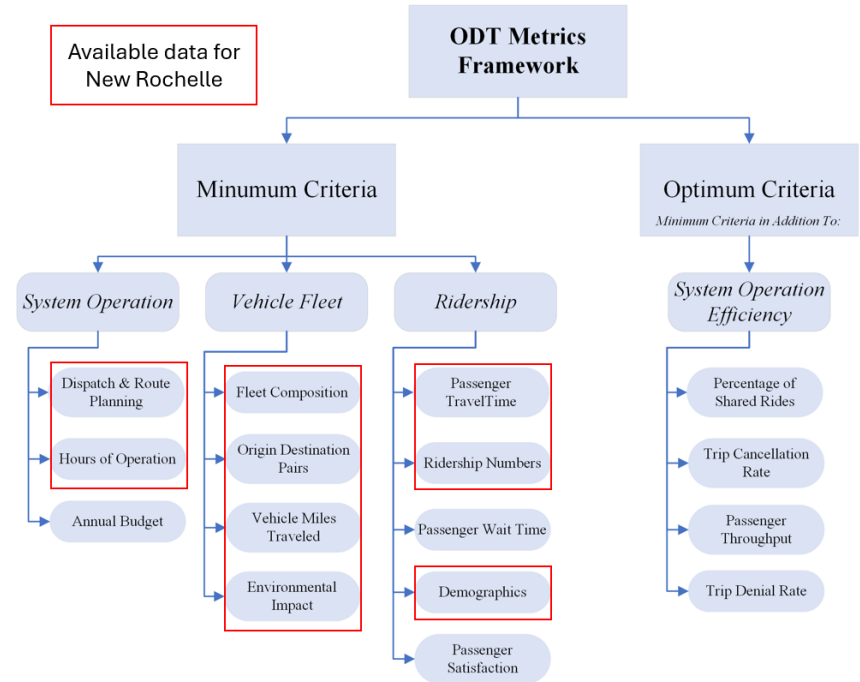
- **Wait time**
  - Average passenger wait time for the system in the first quarter of 2022 was approximately 13.5 minutes.
- **Accessibility**
  - There are currently no ADA/wheelchair-accessible vehicles; however, the city has expressed interest in diversifying the fleet in the future.
- **Passenger satisfaction**
  - Generally positive according to reports from the service provider.
  - Average rider rating is 4.9 out of 5.
  - 97% of riders have expressed wanting to see more vehicles added to the shuttle fleet
- **Fare & Funding**
  - Service is free to ride, supported by multiple funding sources including grants and advertising on vehicles.
  - Initial funding for pilot implementation came from the U.S. Department of Housing and Urban Development Community Development Block Grant Program, CARES Act, and the New Rochelle Industrial Development Agency.
  - CARES Act funding in 2021 helped fund the expansion of the shuttle coverage area and double the fleet size from three to six vehicles.
- **Process for Improvements**
  - The service provider utilizes surveys and analyzes trip pickup and drop-off locations to better tailor their service to the needs of the community and ensure rider satisfaction (e.g., reasonable wait times).



*Circuit electric GEM vehicle at Montefiore Hospital, 2020. Image from [Circuit](#).*

# Data & Methods

- Dataset provided by the service provider included:
  - Count of monthly rides and passengers from September 2019 through December 2023.
  - Aggregated number of passengers by hour and by day of week for 2023.
  - Top 10 pickup and drop-off locations for 2023
  - Total vehicle miles traveled (VMT) in 2023.
  - Percentage of ridership by age group and gender in 2023.
  - Trip-level data for 2023 with ride date, day of week, hour, drop-off and pickup latitude/longitude coordinates, and total riders.

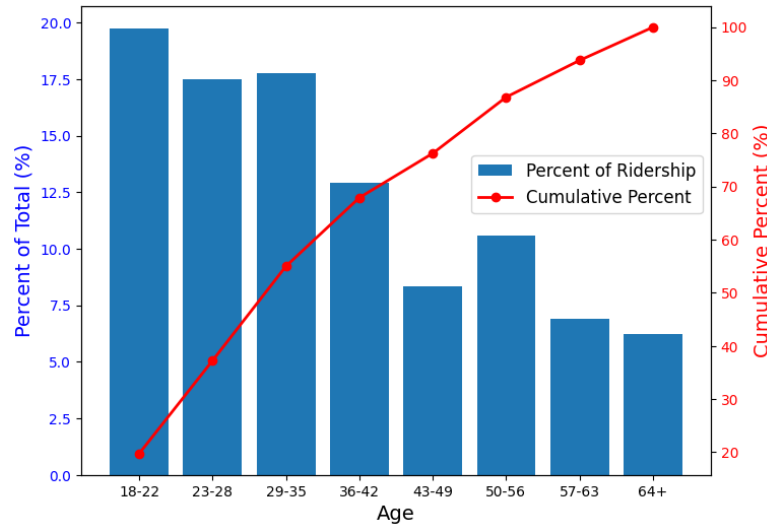


*Minimum and optimum criteria to analyze ODT services, with relevant data available and analyzed for this case study outlined in red. Some limited information was also available for passenger wait time, passenger satisfaction, and percentage of shared rides.*

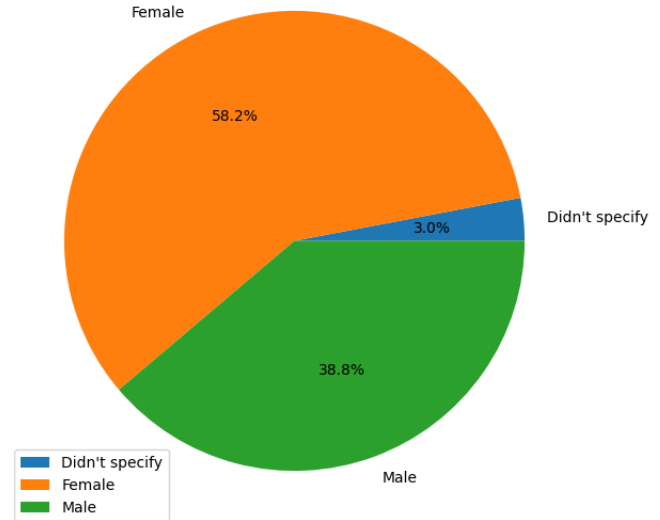


# Sociodemographic Results

- Predominant demographics are young and female.



Ridership by Age

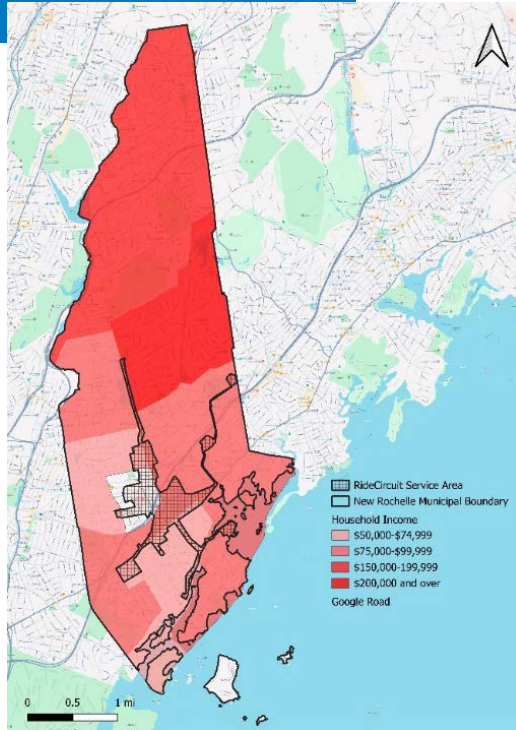


Ridership by Gender

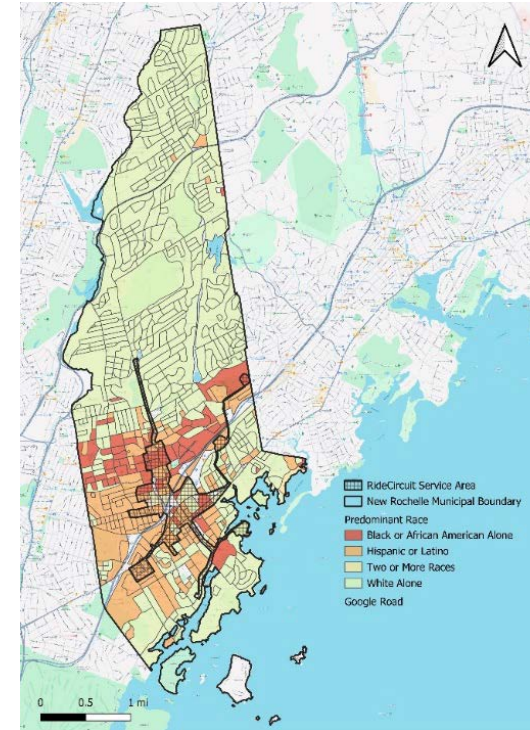
# Sociodemographic Results

- ODT service area is in a low-income area of the city.

Household income and ODT service area



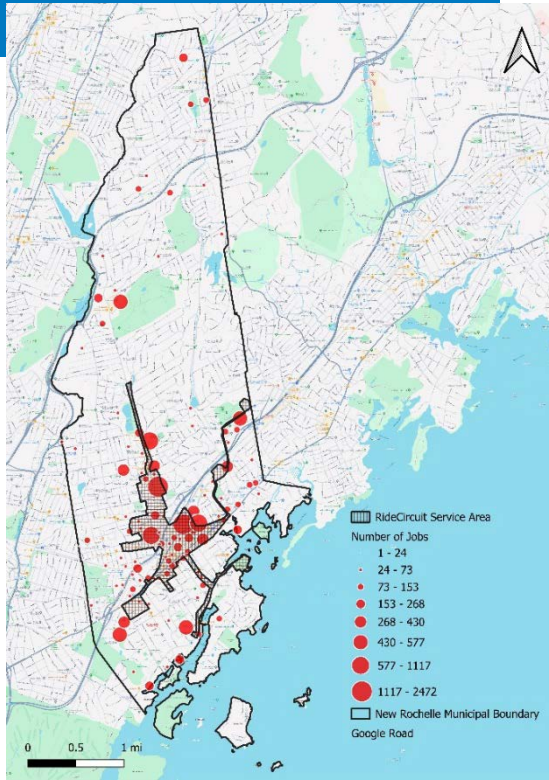
Racial demographics and ODT service area



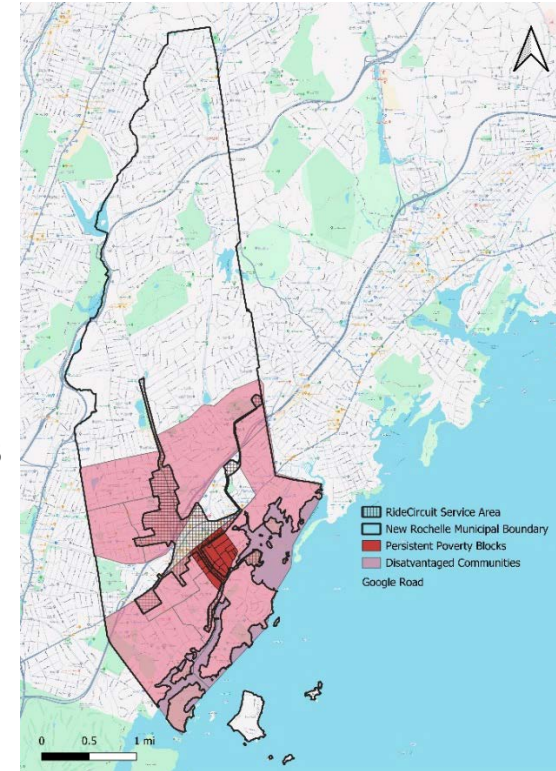
# Sociodemographic Results

- Many of the jobs in the city are concentrated in the ODT service area (downtown).

Jobs and ODT service area

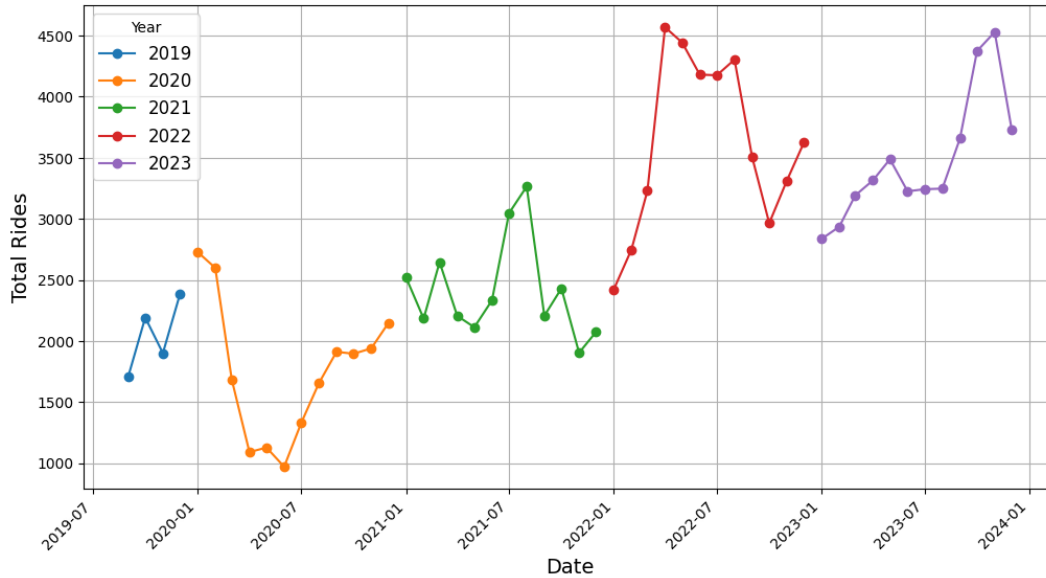


Disadvantaged communities and persistent poverty tracts and ODT service area

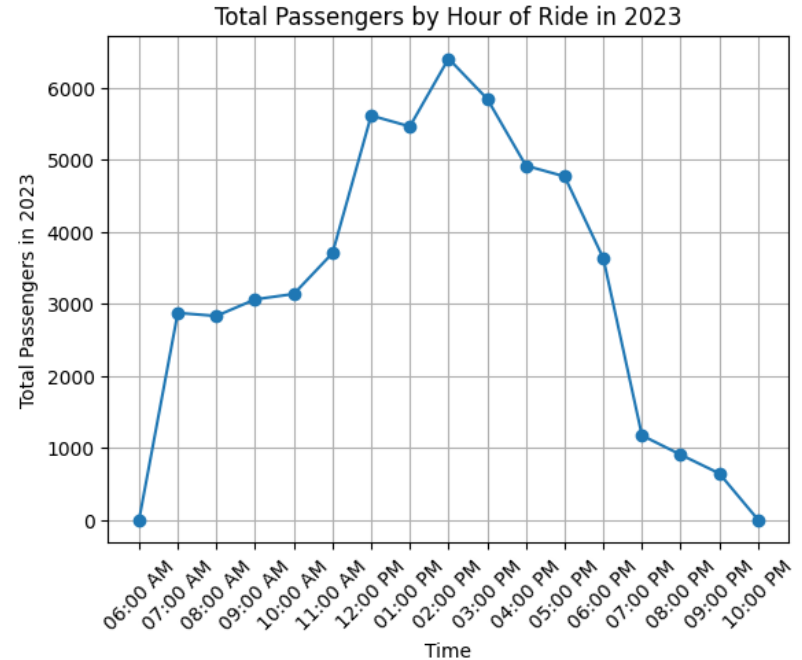


# Sociodemographic Results

- Overall trend of increased ridership since launch in 2019.
- Peak demand occurs mid-day (1-2pm).
- Ridership is slightly lower on the weekends.
- Cost to transit agency per ride was not available.



Monthly rides over time, from system launch in August 2019 through December 2023



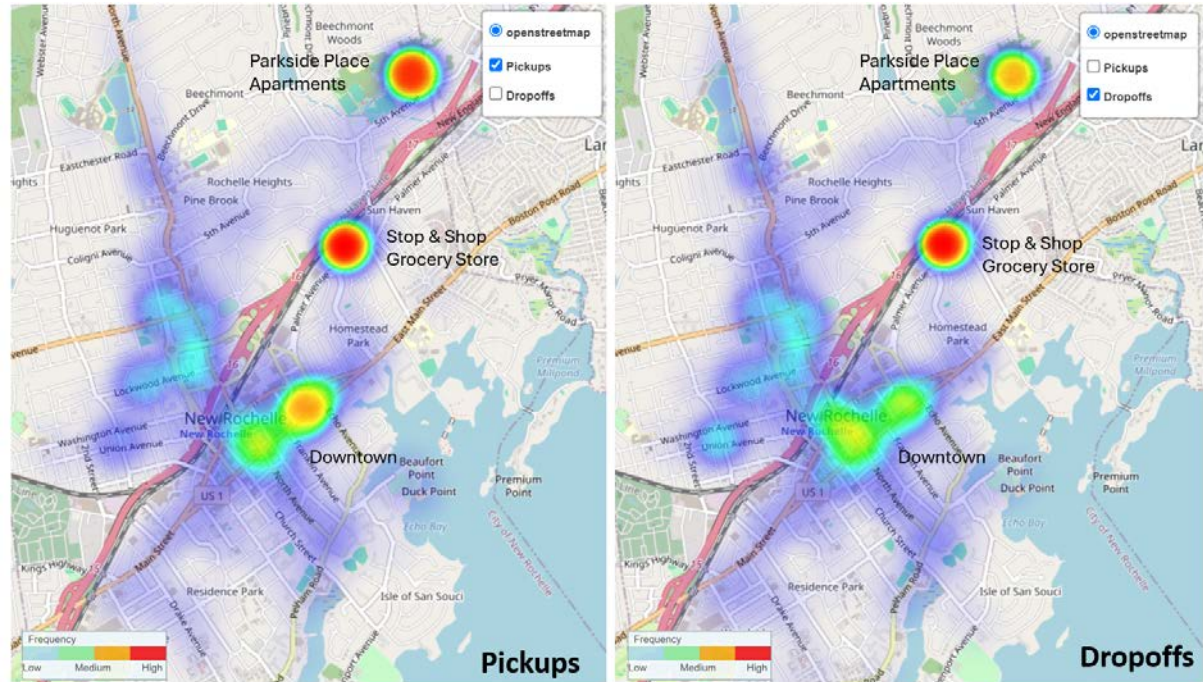
Total passengers by ride hour in 2023



# Spatiotemporal Results

- Little difference between locations of app-requested and street-hailed pickups.
- Weekend pickups were slightly more concentrated geographically than weekday pickups, potentially suggesting broader use on weekdays.
- Heatmaps can be used to glean insights into service use.

Heat map of pickup and drop-off locations for all trips in 2023, weighted by rider frequency





# Energy & Emissions Results

- **NREL's RouteE Compass tool** used to estimate trip distances from pickup/drop-off latitude/longitude coordinates.
  - ODT service primarily used for **short trips** (48% < 1 mile, 86% < 2 miles).
  - Learn more about RouteE at: <https://www.nrel.gov/transportation/route-energy-prediction-model.html>
- Total annual VMT reported by the service provider; used to estimate **emissions from charging / re-fueling for different fleet scenarios**.
  - Small, right-sized EVs have CO<sub>2</sub> emissions associated with charging that are roughly 1/4<sup>th</sup> of the fleet emissions of conventional hybrid vans, and nearly 50 times less than a fleet of diesel buses.



Fleet Scenario	Miles Traveled	Energy Intensity (kWh/mile)	Fuel Economy (miles per gasoline gallon equivalent)	Annual Emissions (kg CO <sub>2</sub> )	Estimated Annual Cost of Fuel and/or Charging
Electric GEM vehicles (baseline)	20,000	0.22 <sup>d</sup>	N/A	1,080	\$1,040
Ford E-Transit van (electric)	20,000	0.56 (55)	N/A	2,748	\$2,648
Chrysler Pacifica plug-in hybrid	20,000	0.41 (56)	82 (electric and gas), 30 (gas only)	3,517	\$2,174
Toyota Sienna hybrid	20,000	N/A	36 (58)	4,878	\$2,111
Fort Transit van	20,000	N/A	26 (59)	6,754	\$2,923
Chrysler Pacifica	20,000	N/A	22 (56)	7,982	\$3,455
Diesel transit bus	20,000	N/A	3.4	51,647	\$25,000

Estimated Annual Emissions and Refueling/Charging Costs from Vehicles for Baseline EVs Compared to Other Electric, Gasoline, and Diesel Vehicles. See report for data sources.

# Conclusion

## Key Findings

- ODT service is **efficient for shorter trips** in terms of energy use / emissions. 86% of trips were under 2 miles and almost all (99.5%) were under 3 miles.
- 58% of riders identified as **female** and 68% **under age 43**.
- Peak use was during the **middle of the day**, with the Stop & Shop **grocery store** being a popular origin and destination.
- The service meets a **key public need**, with services continuing to be used and growing since the COVID-19 pandemic.



*Photo by Werner Slocum , NREL 15931*

## Looking Ahead

- Experimenting with **smart stops** (where customers walk a block or two to an optimal pickup location) is one opportunity being explored for further improvements to system efficiency.
- Fleet **right-sizing of vehicles** according to demand—including shuttles, sedans, and vans—may be another consideration for this community and others. However, increased complexity must be considered.

# Future Research

Areas of future research for the New Rochelle ODT system include:

- **Electric vehicle fleet and infrastructure**

- Total cost of ownership for electric vs. international combustion engine fleet vehicles
- EV charging infrastructure including locations, utilization, costs, perception, peak periods, and grid impacts.

- **Trip purposes**

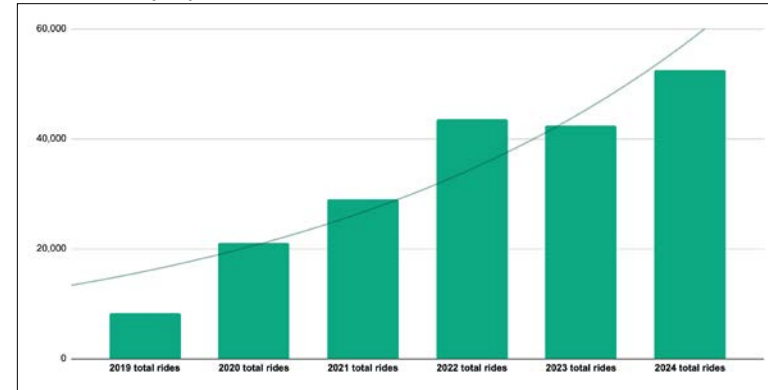
- Surveys to determine types of trips taken and if system is used for commuting purposes
- Estimate percentage of ODT trips used to connect to other types of transit including fixed-route bus and rail. This could lead to the community installing signs identifying clear locations near popular bus or rail stations for ODT service pick-up, making it easier for riders to locate the vehicle.

- **Cost-effectiveness of ODT system and growth**

- Examine strategies for sustainable growth of the ODT system and managing demand during peak periods, such as implementing time-of-use pricing or deploying additional vehicles, while still keeping the public service affordable.
- Analysis of service costs, including labor costs, is needed.
- Cost-effectiveness of our studied ODT systems is currently inconclusive due to lack of available data.



Photo by Dennis Schroeder, NREL 54632.



New Rochelle Annual Ridership, 2019-2024. Figure from Circuit.

# Questions?

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**[www.nrel.gov](http://www.nrel.gov)**

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